

The Ecosystem Approach: Healthy Ecosystems *and* Sustainable Economies

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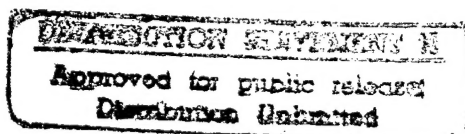
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Report of the Interagency Ecosystem Management Task Force
November 1995

THE ECOSYSTEM APPROACH:

Healthy Ecosystems *and* Sustainable Economies

Volume II—Implementation Issues



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REPORT OF THE
INTERAGENCY ECOSYSTEM MANAGEMENT TASK FORCE
November 1995

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LIST OF ABBREVIATIONS

CBEP	Community-based environmental protection	HCP	Habitat Conservation Plan
CENR	Committee on the Environment and Natural Resources	ISTEA	Intermodal Surface Transportation Efficiency Act
CEQ	Council on Environmental Quality	NCP	National Oil and Hazardous Substances Pollution Contingency Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act	NEEA	National Environmental Education Act
Corps	U.S. Army Corps of Engineers (U.S. Department of Defense)	NEPA	National Environmental Policy Act
CRP	Conservation Reserve Program	NGO	Nongovernmental organization
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act	NMSA	National Marine Sanctuaries Act
CWA	Clean Water Act	NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
CZMA	Coastal Zone Management Act	NSTC	National Science and Technology Council
EIS	Environmental impact statement	O&C	Oregon and California
EPA	Environmental Protection Agency	OMB	Office of Management and Budget
ESA	Endangered Species Act	OPA	Oil Pollution Act
FACA	Federal Advisory Committee Act	RAP	Remedial Action Plan
FLPMA	Federal Land Policy and Management Act	SEP	Supplemental Environmental Project
FOIA	Freedom of Information Act	USDA	U.S. Department of Agriculture
FY	Fiscal year	USGS	U.S. Geological Survey
GSA	General Services Administration	WRDA	Water Resources Development Act

Chapter 1: INTRODUCTION

Vice President Gore's National Performance Review recommended that federal agencies adopt "a proactive approach to ensuring a sustainable economy and a sustainable environment through ecosystem management." The link between a healthy economy and a healthy environment has highlighted the need to actively maintain our natural infrastructure before problems arise, as we do with our highways and bridges. The Interagency Ecosystem Management Task Force was established to implement an ecosystem approach to environmental management.

PRINCIPLES OF THE ECOSYSTEM APPROACH

An ecosystem is an interconnected community of living things, including humans and the physical environment with which they interact. As such, ecosystems form the cornerstones of sustainable economies. The goal of the ecosystem approach is to restore and maintain the health, sustainability, and biological diversity of ecosystems while supporting sustainable economies and communities. Based on a collaboratively developed vision of desired future conditions, the ecosystem approach integrates ecological, economic, and social factors that affect a management unit defined by ecological—not political—boundaries.

Because ecosystems do not follow administrative boundaries (such as the borders of national parks or forests), working to maintain or restore ecosystem sustainability involves a perspective that crosses those artificial boundaries. This entails a shift from the federal government's traditional focus on individual agency jurisdiction to a broader focus on the actions of multiple agencies within the larger ecological boundaries. Just as collaboration is important, finding ways to increase voluntary cooperation with state, tribal, and local governments, as well as nongovernmental organizations and the public, is key to an effective ecosystem approach.

The Interagency Ecosystem Management Task Force has developed a set of common principles for federal resource management and regulatory

agencies to follow in implementing the ecosystem approach (Interagency Ecosystem Management Task Force 1995, volume 1):

- Develop a shared vision of the desired ecosystem condition, taking current social and economic conditions into account and identifying ways in which all parties can contribute to achieving common ecosystem goals.
- Develop coordinated approaches among federal agencies to accomplish ecosystem objectives, and collaborate with local, state, and tribal parties based on recognition of mutual concerns.
- Use ecological approaches that restore and sustain the biological diversity, health, and productivity of ecosystems.
- Support actions that incorporate sustained economic, sociocultural, and community goals consistent with the vision.
- Respect private property rights, and work cooperatively with private landowners to accomplish shared goals.
- Recognize that ecosystems and institutions are characteristically complex, dynamic, heterogeneous over space and time, and constantly changing.
- Use an adaptive approach to management to achieve both desired goals and a new understanding of ecosystems.
- Integrate the best science and knowledge available into the decision-making process while continuing scientific research to improve the knowledge base.
- Establish baseline conditions for ecosystem functioning and sustainability against which change can be measured. Monitor and evaluate actions and their outcomes to determine if goals and objectives are being achieved.

IDENTIFYING ISSUES IN IMPLEMENTING THE ECOSYSTEM APPROACH

Many factors, such as interagency conflicts, incompatible data bases, an incomplete understanding of ecosystem functioning, inconsistent planning and budgetary cycles, and differing agency organizational structures, have hampered development of a coordinated approach to actively maintaining or restoring the health of ecosystems. The Interagency Ecosystem Management Task Force, acting through its Working Group, examined major issue areas that influence the effectiveness of the ecosystem approach and made recommendations for improvements. Areas chosen for examination were:

- Budget issues
- Institutional issues
- Public participation
- Science and information management
- Legal authorities

The Working Group chose interagency groups to study each issue. Groups consisted of from 9 to 18 representatives of federal agencies. Agencies represented on one or more issue groups included the U.S. Army Corps of Engineers, Bureau of Land Management, Bureau of Mines, U.S. Coast Guard, Council on Environmental Quality, Environmental Protection Agency, Federal Aviation Administration, Federal Highway Administration, U.S. Fish and Wildlife Service, U.S. Department of Agriculture (USDA) Forest Service, National Biological Service, National Oceanic and Atmospheric Administration, National Performance Review, USDA Natural Resources Conservation Service (formerly Soil Conservation Service), Office of Management and Budget, Office of Science and Technology Policy, Smithsonian Institute, U.S. Department of Defense, U.S. Department of Energy, U.S. Department of Housing and Urban Development, U.S. Department of the Interior, U.S. Department of Justice, and U.S. Department of Transportation. Although agency representation varied from group to group, it broadly reflected the makeup of the Interagency Ecosystem Management Task Force and Working Group.

Issue groups based their findings on efforts across the nation to implement the ecosystem approach, particularly on seven case studies conducted by interagency survey teams. The Interagency Ecosystem Management Task Force selected seven ecosystems for study:

- Anacostia River watershed
- Coastal Louisiana
- Great Lakes basin
- Pacific Northwest forests
- Prince William Sound
- South Florida
- Southern Appalachians

The Interagency Ecosystem Management Working Group commissioned interagency teams to survey each ecosystem selected for study. Primarily through interviews with interested parties in each ecosystem, teams identified opportunities for—and constraints to—interagency coordination of the ecosystem approach (see volume 3, *Interagency Ecosystem Management Task Force 1995*). Issue groups drew on these findings to identify and discuss key issues related to implementing the ecosystem approach.

ISSUE GROUP FINDINGS

Issue groups found that federal agencies have launched efforts to implement aspects of the ecosystem approach in many parts of the country. Obstacles encountered have led to mixed success.

Budget Issues

Budgetary measures that federal agencies are taking to help implement the ecosystem approach include discretionary spending requests and interagency budget coordination in ecosystems around the country. In addition, federal agencies are creating ecosystem accounts in their budgets and providing more flexibility to budget structures.

Obstacles to interagency cooperation include differences among the congressional committees that authorize and appropriate funds for the various

federal agencies. Lack of future funding certainty can impede implementation of long-term projects. Agency mandates impose limitations on the kinds of projects that agencies can undertake. Differences in agency budget structures and difficulties in pooling and transferring funds seriously impede interagency coordination. Moreover, some agencies may have little experience in cooperating with nonfederal partners, and agency staff may be reluctant to coordinate with other agencies.

Obstacles to intra-agency reform include traditional budget priorities, which may block efforts to fund the ecosystem approach. Time limitations imposed by Congress on use of funds, narrow funding controls, and constraints on reprogramming of funds may prevent programs from being implemented that might otherwise contribute to the ecosystem approach.

Institutional Issues

Institutional arrangements to expedite the ecosystem approach depend on the following: a shared vision for the ecosystem in collaboration with all stakeholders; adaptive management; an appropriate organizational structure; performance measures and accountability; information accessibility, usability, and communication; and suitable training and education. The institutional issues group found that in each of these regards, federal agencies are making substantial progress in implementing an ecosystem approach in some ecosystems around the country.

The group found that in some cases, agency missions and mandates hamper development of shared visions for ecosystems. Highly functional agency approaches may interfere with a broad ecosystem approach, as do agency jurisdictional boundaries that rarely coincide with ecosystems. In general, information required for the ecosystem approach is difficult to acquire and use, and may be sensitive or proprietary. Finally, agency personnel may lack training in collecting, analyzing, using, and communicating ecosystem information, particularly when it is unclear what information should be collected.

Public Participation

Successful implementation of the ecosystem approach depends on involving all stakeholders in

planning, decision making, and implementation. The public participation issues group found that federal agencies in many cases are providing public access to information on planning and technical documents, developing educational programs on environmental concerns, and engaging the public in dialogue at various stages of projects, both before and during implementation.

The group also found considerable room for improvement, particularly in the following areas: facilitating early and continuous public input into decision making; empowering a public not always privy to expert technical information; incorporating the human dimensions of environmental problems into the ecosystem approach; ensuring that planned efforts accord with public expectations; and providing constant feedback throughout the course of a project.

Science and Information Management

Agency programs in science and information management contribute to the ecosystem approach in several ways: by increasing the potential for interagency collaboration and helping to involve nonfederal stakeholders; by raising the credibility of science and information as the basis for decision making; by making information available to decision makers, scientists, and the public; and by developing new ecosystem-oriented adaptive management strategies. In order to break down traditional science-related barriers to a systems approach, the National Science and Technology Council, through the Committee on the Environment and Natural Resources, has developed a process for replacing traditional single-agency, single-discipline problem solving with a coordinated multiagency, interdisciplinary approach that brings together natural and social scientists, economists, engineers, and policymakers. The Committee provides leadership for strategic planning, coordination, and prioritization of research and assessment objectives across all federal agencies.

However, there are several science-related barriers to the ecosystem approach. Research faces budgetary and political constraints, in part due to poor relationships of scientists with managers and the public. Gaps in knowledge about how ecosystems work are not filled fast enough, partly due to a traditional focus on narrow topics and limited disciplines. Reporting of research data should be

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standardized, and access to data and information should be structured to better facilitate synthesis and integration for resource managers and to provide feedback on information gaps. Finally, federal agencies are not putting enough emphasis on long-term monitoring and evaluation after projects are completed.

Legal Authorities

Federal agencies can take advantage of major legal authorities to implement the ecosystem approach. Authorities such as the National Environmental Policy Act, Endangered Species Act, Clean Water Act, and Marine Mammal Protection Act were designed to facilitate cooperation among stakeholders in protecting habitats and preventing pollution in ecosystems nationwide. Statutes governing management of federal lands, such as the Multiple Use–Sustained Yield Act and Federal Land Policy Management Act, provide the authority for agencies to protect, sustain, and restore ecosystems on the lands they manage. Additional statutes are designed to protect specific ecosystems, such as the Coastal Zone Management Act and Wild and Scenic River Act. Agencies can use all three types of authorities to preserve the integrity of ecosystems and to promote the sustainable communities and economies that depend on these ecosystems.

Although these statutes may be used in pursuit of goals under the ecosystem approach, they may also be interpreted in ways that constrain such efforts. For example, under statutes such as the Endangered Species Act, agencies may establish regulations and programs that focus primarily on individual species rather than on the broader ecosystem context. Such statutes tend to trigger action only when drastic measures are needed for recovery of a species or habitat.

Antipollution statutes (such as the Clean Air Act or Clean Water Act) may focus attention on a single medium, rather than on the complex interactions among various media across ecosystems and regions. The number of different permits required for some activities (a different permit for each medium affected) may create public confusion and resentment.

Finally, the cornerstone of an ecosystem approach—collaboration among all stakeholders—

may have been weakened by the Federal Advisory Committee Act, which has in the past constrained collaboration between federal and nonfederal parties.

RECOMMENDATIONS

Based on these findings, issue groups recommended ways of addressing constraints to the ecosystem approach. In general, agencies should use the ecosystem approach as a tool rather than as an end in itself. It cannot replace existing measures, rules, policies, and procedures, but should instead be incorporated into them. In particular, the ecosystem approach should be implemented as a process of stakeholder participation, and as a process of planning that analyzes the interactive effects of all elements in an ecosystem.

Specific recommendations included the following:

- ***Develop ecosystem budgets.*** Agencies should establish mechanisms to facilitate interagency ecosystem budgeting. The setting of budget priorities should be better defined.
- ***Evaluate and revise institutional structures and cultures.*** Agencies should strive for flexibility in pursuing their missions, increase regional coordination, develop common ecosystem indicators, take advantage of electronic technology for sharing ecosystem information and improving communication, foster interagency personnel exchanges, and coordinate plans and activities with state and local jurisdictions.
- ***Increase federal commitment to public involvement, and provide education and technical assistance so that all stakeholders understand why the ecosystem approach is needed and how it functions.*** Agencies should establish coordinated interagency public participation programs that facilitate two-way communication with the public and encourage public participation from the earliest stages of projects. Imaginative tools and techniques should be developed to educate the public and to involve all stakeholders in efforts to implement the ecosystem approach.

- ***Integrate basic and applied ecological, social, and economic research; and promote easier access to federal funding assistance and information for ecosystem management.*** An integrated research program should include: more adaptive and flexible management systems; a broader base of public support; improved information for decision making; ways to link ecological, social, and economic objectives at different scales for planning and decision making; methodologies for predicting ecosystem responses to management activities; and methodologies for integrated planning and management across site, landscape, and regional levels. Regional clearinghouses for information and coordination on monitoring, analytical tools, best management practices, public participation techniques, restoration initiatives, and other matters could be developed.
- ***Use legal authorities to promote the ecosystem approach.*** Agencies should take full advantage of legal authorities to develop ecosystem-oriented approaches and to protect ecological values. They should coordinate their activities at the ecosystem level and implement environmental laws in ways designed to promote ecosystem integrity. Agencies should form partnerships with private landowners and work with all stakeholders, establishing "one-stop" permitting, and finding ways to overcome the barriers posed by the Federal Advisory Committee Act. Finally, they should use the Intergovernmental Personnel Act to build lasting partnerships with each other and with other government entities in pursuing the ecosystem approach.

Chapter 2: BUDGETING FOR THE ECOSYSTEM APPROACH

Federal agencies are taking measures to revise budget development and execution procedures to facilitate an ecosystem approach. They are beginning to coordinate more with each other, and with nonfederal parties, on budget planning. Several agencies are making internal organizational changes that will lead to the development of budgets that better accommodate ecosystem approaches. Examples of such changes are provided in the first section of this chapter.

Federal agencies face several budget-related challenges to adopting an ecosystem approach. There is a need for greater coordination on budget planning and execution, increased flexibility to reprogram funds in response to changing needs, greater consistency in definition of budget activities between agencies, and greater expertise in working with nonfederal partners. These challenges are discussed in the second section of this chapter, partly based on comments made by those interviewed by interagency survey teams in seven ecosystems across the country (see volume 3 in this series, Interagency Ecosystem Management Task Force 1995). Recommendations of ways to address these challenges are provided in the third section of this chapter.

FEDERAL MEASURES TO FACILITATE THE ECOSYSTEM APPROACH

The Clinton administration has taken a number of steps to increase the extent to which budgets and budget-related processes facilitate an ecosystem approach. Coordination among several federal agencies on budget planning and execution is increasing, and agencies are making internal organizational changes that will lead to budget planning and execution processes more focused on the ecosystem approach. Highlights include discretionary spending for the ecosystem approach and interagency budget coordination in seven key ecosystems.

Discretionary Spending

Discretionary spending for interagency implementation of the ecosystem approach was requested in the fiscal year (FY) 1995 budget. The FY 1995

budget requested \$610 million in discretionary spending for ecosystem approach initiatives, mostly to support interagency efforts in the Pacific Northwest and South Florida ecosystems. Congress supported this initiative by appropriating \$680 million. The Administration's commitment will continue in FY 1996, with a proposed increase of \$42 million over spending requested for ecosystem approach initiatives in FY 1995.

Interagency Budget Coordination

In seven ecosystems across the nation (the Anacostia River watershed, Coastal Louisiana, the Great Lakes basin, the Pacific Northwest forests, Prince William Sound, South Florida, and the Southern Appalachians—see Interagency Ecosystem Management Task Force 1995, volume 3), federal agencies are beginning to coordinate budget planning or take steps that could lead to increased coordination.* In some of these areas, agencies are also increasing coordination of budget execution consistent with budget planning. Other efforts to coordinate federal and nonfederal budgets on broader scales are also underway. For example, under the Coastal America Program, federal agencies are coordinating budgets to complete environmental projects in the nation's coastal areas.

Anacostia River watershed. Efforts to implement the ecosystem approach in the Anacostia River watershed have been locally driven. Although there has been some coordination of local agency budgets, there has been little central coordination, if any, on the federal side. However, the July 4, 1994, signing of the "Agreement by Federal Agencies on Ecosystem Management in the Chesapeake Bay" will promote a coordinated federal ecosystem workplan, which may produce more

*In most of these areas, interagency bodies are not necessarily responsible for coordinating activities related to all resources in the entire ecosystem. In the Pacific Northwest, for example, interagency coordination on the President's Forest Plan is limited to managing the forest ecosystem, and does not address fishery issues; and in Prince William Sound, an interagency body was formed to coordinate restoration of resources damaged following the *Exxon Valdez* oil spill, so its activities are limited to a geographic area defined by the travel of oil rather than by a wide range of ecological functions.

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budgetary cooperation among federal agencies. The U.S. Army Corps of Engineers (Corps) will be the lead coordinating agency for the workplan.

In addition to the Corps' activities, carried out in close cooperation with surrounding states and local governments, the Environmental Protection Agency (EPA), National Park Service, and U.S. Department of Agriculture (USDA) also have ecosystem restoration activities underway in the Anacostia River basin, requiring increased interagency coordination of budgets and operational activities. These federal activities can complement local efforts by providing additional expertise and resources to address concerns affecting both the local Anacostia watershed and such larger ecosystems as the Chesapeake Bay.

Coastal Louisiana. In Coastal Louisiana, a coordinated approach to project planning and budgeting is being taken by the task force established under the authority of the Coastal Wetlands Planning, Protection, and Restoration Act of 1990, 16 U.S.C. 3951–3956. The federal agencies involved in ecosystem restoration and protection have developed the Louisiana Coastal Wetlands Restoration Plan, under which plans have been formulated for each of the state's nine coastal hydrologic units. Three lists of priority projects have been prepared, and 4 of 49 priority projects have been implemented.

Great Lakes basin. In the Great Lakes basin, the Northeast-Midwest Institute (a nongovernmental organization) provides recommendations to Congress for federal funding of agency activities affecting the Great Lakes. Beyond this effort, coordination of federal budgets is minimal.

Pacific Northwest forests. In the Pacific Northwest, an interagency budget has been assembled from budget information provided by individual agencies, based upon agreements under the Forest Plan of 1993. This budget is characterized by coordinated single-agency activities, as opposed to individual tasks performed together by multiple agencies. In addition to these interagency agreements to cooperate on forest management issues, numerous federal and state agencies are coordinating funding and activities related to endangered salmon recovery programs.

Prince William Sound. Federal and state agencies with oversight responsibilities for restoration

efforts in Prince William Sound following the 1992 *Exxon Valdez* oil spill have formed an interagency team and are working closely together to administer funds from the Exxon settlement. However, a lack of clear objectives early in the process resulted in considerable difficulties regarding fund allocation (see chapter on Prince William Sound in Interagency Ecosystem Management Task Force 1995, volume 3). This problem is being addressed through the development of guiding principles, goals, and a restoration plan. Because the focus of interagency efforts has been on restoring resources damaged in the aftermath of the oil spill, agencies have concentrated on areas affected by the spill.

South Florida. In the South Florida ecosystem, agencies are sharing budget plans for FY 1996 and discussing interagency funding priorities on an ecosystem-wide basis. The Corps and National Park Service are working together on design of some projects. The U.S. Fish and Wildlife Service and National Park Service, both in the Department of the Interior, have coordinated closely on planning to address water quality issues. Most projects are funded by single agencies, although the National Park Service provides funds to the Corps to modify water deliveries in the East Everglades.

Southern Appalachians. The Southern Appalachian Man and the Biosphere (SAMAB) program is working towards increasing interagency cooperation in the broad ecosystem along the southern Appalachian Mountains. The SAMAB has facilitated development of a framework for interagency cooperation that, once finalized, will form the basis of an interagency proposal and budget for activities to implement the ecosystem approach. Although no interagency budget has yet been developed, eight agencies are cooperating in providing support to SAMAB and to ecosystem-related projects that SAMAB is facilitating.

Coastal America Program. Although not an ecosystem, the Coastal America Program provides another example of interagency coordination on budget formulation and execution. In this program, federal agencies work together and in partnership with nonfederal parties (strongly represented) to identify priorities and issues concerning land, water, and other natural resources in the nation's coastal areas. Partners in the program then jointly identify projects supportable through existing authorities, in accordance with an agreed-upon, locally defined strategy. By empowering local and

private partners, the program far exceeded its goal of 25 percent nonfederal funding. Indeed, in the program's first year, federal spending was matched dollar for dollar by nonfederal funding.

Much of the coordination for this effort is provided by the following teams: the Principals Group (policy-level federal agency representatives based in Washington, DC); the National Implementation Team (midlevel managers, also based in Washington, DC); and Regional Implementation Teams (based in nine coastal regions of the country).

Revising Budget Structures and Processes

Many federal agencies are revising budget structures and processes to facilitate an ecosystem approach within the appropriation limits established by Congress. Federal agencies are reducing the number of budget line items, creating ecosystem accounts, and providing more flexibility to budget structures. The Civil Works Program of the Corps, for example, has long corresponded to river basins and watersheds, potentially facilitating future efforts to structure budgets on an ecosystem basis. Other agencies making revisions include the Bureau of Land Management, EPA, Fish and Wildlife Service, USDA Forest Service, and National Oceanic and Atmospheric Administration.

Bureau of Land Management. The Bureau of Land Management has been restructured internally in an attempt to facilitate the implementation of the ecosystem approach, gain flexibility to respond to changing conditions, and generally improve the efficiency of agency operations. Major elements of change involve consolidation of previously segregated program areas, establishment of a team structure for decision making, and focusing efforts on five overarching strategic goals, two of which are restoring and maintaining the health of the land, and improving service to the public while encouraging sound resource use practices.

In order to better implement these organizational improvements, the Bureau is implementing a new budget structure to permit allocation of funds based on overall mission rather than on separate, often conflicting programs. The new budget structure emphasizes ecosystem approaches and will save an estimated \$4 million annually. It collapses the agency's 24 accounts for management of land resources into 10 new "activity" accounts, and fund controls apply only to these accounts. It also

eases restrictions on reprogramming authority and may make all operating appropriations effective as "no-year" appropriations.

At the field level, the Bureau's Idaho State Office is making budget-related changes as part of a larger effort to adopt the ecosystem approach. Changes include restructuring its budget in accordance with ecosystem boundaries and reducing the number of budget accounts.

Environmental Protection Agency. EPA's recently drafted Five-Year Strategic Plan lays out seven guiding principles for strategy development and implementation. These principles include ecosystem protection through cultivating the growth of ecosystem management and economic development that promotes the health and productivity of natural systems. Together, these principles form on the factors guiding decisions at EPA.

Early in its Strategic Plan, EPA notes that future plans will be geared toward a set of measurable environmental goals being developed through EPA's National Environmental Goals Project. The Project should help EPA to better focus its efforts on environmental results, including ecosystem protection. Project goals (such as clean air, clean waters, safe waste management, and healthy terrestrial ecosystems) are being used to frame EPA's budget and are designed to drive future budget decisions. Although the basic budgeting process is not expected to change, each program office is required to explain how its budget requests support each of the environmental goals.

In addition, EPA is piloting multimedia, multipurpose grants in several states under the performance partnership proposal. These grants provide for combining air, water, and hazardous wastes program grants for use in critical watersheds and ecosystems. By combining and streamlining the administration of these grants, EPA believes it can obtain greater environmental results at less cost.

Fish and Wildlife Service. The Fish and Wildlife Service has made a proposal to reorganize its programs and reduce the complexity of its budget structure in order to enhance its ability to undertake multidisciplinary ecosystem initiatives. The agency has adopted an ecosystem team approach to decision making as the foundation of its budget process. Although the agency will remain active throughout the country, budget

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increases and/or resource shifts will go to benefit those ecosystem units most important to the agency's trust resources. The agency will focus on ecosystem units where it has the greatest likelihood of using its capabilities and tools, in partnership with others, to bring about the greatest results.

Within each ecosystem unit, ecosystem teams will establish budget priorities and develop 3-year action plans that include the costs of planned activities. The action plans will guide budget execution.

Forest Service. The Forest Service has made a number of revisions in its budget structure and related processes, through changes proposed in the Budget Explanatory Notes for the FY 1995 President's Budget. The additional flexibility gained from these reforms is accompanied by congressional expectations and requirements for increased accountability in budget execution (through better accounting for expenditures and the development, improvement, and use of performance measures).

Approved revisions include:

- A simplified budget structure. The agency received a significant consolidation of line items within the National Forest System, State and Private Forestry, and Forest Research appropriations (from 58 to 34 line items).
- A new budget line item for the ecosystem approach. The National Forest System appropriation contains a new line item for "Ecosystem Planning, Inventory, and Monitoring."
- Expanded reprogramming authority. This additional authority allows for greater flexibility in shifting funds between line items within each appropriation.

In addition to making these changes, the Forest Service is shifting its budget priorities, based on the new emphases of its strategic agenda, as defined by the Resources Planning Act Program update. Although the 1990 Resources Planning Act Program contained themes tied to specific agency programs, the 1995 draft Program focuses agency priorities on restoring and protecting ecosystems and ensuring that the organization operates in an effective and efficient manner.

Specific priority shifts have focused on restoring and maintaining forest health by providing more funds for forest health management, forest land vegetation management, and watershed improvements.

The fact that the Forest Service and Bureau of Land Management are making similar budget revisions may advance efforts to implement the ecosystem approach by making it easier to track, match, and/or pool interagency expenditures and to address ecological resource issues that transcend administrative boundaries.

National Oceanic and Atmospheric Administration. The National Oceanic and Atmospheric Administration (NOAA) has made organizational changes to better integrate and facilitate ecosystem approaches. In 1993, NOAA focused its Ten-Year Strategic Plan on two primary missions: environmental assessment and prediction (describing and predicting changes in the earth's environment); and environmental stewardship (conserving and wisely managing the nation's coastal and marine resources to ensure sustainable economic opportunities). In accordance with these missions, the agency's planning, budgeting, and implementation activities are oriented toward seven strategic goals, providing a new level of unity and focus to the agency.

In 1994, NOAA conducted an extensive review of its coastal stewardship activities to determine how better to integrate its resources to most efficiently and effectively fulfill its coast-related statutory mandates. The strategic planning process and review of coastal stewardship activities have led to significant changes in the way NOAA plans and evaluates its activities and budgets, emphasizing broader regional efforts, partnerships, and constituent participation—all key aspects of ecosystem approaches.

CHALLENGES TO THE ECOSYSTEM APPROACH

Federal agencies will continue to revise budget planning and execution procedures to facilitate an ecosystem approach. However, such efforts face two types of challenges: constraints to interagency cooperation, and obstacles to intra-agency reform. The first type of challenge includes barriers to increased cooperation among agencies and between agencies and nonfederal parties. The

second type of challenge includes difficulties that agencies face in making internal changes to budget processes.

Constraints to Interagency Cooperation

A successful ecosystem approach will be facilitated by the development of interagency ecosystem budgets based on an ecosystem vision developed through consensus among stakeholders. Several mechanisms exist for achieving this. However, even where specific, high-priority ecosystems have been designated by the Administration, agencies face significant institutional, legal, and organizational constraints to interagency cooperation, many of which relate to the reality of competing interests and objectives throughout the nation.

Congressional committee differences. Division of responsibility for authorizations and appropriations among congressional committees can make interagency coordination difficult. Because agency budgets are appropriated under different congressional committees and authorities, there is no assurance of consistent perspectives or priorities, and budget considerations are subject to varying constraints and competing interests. In South Florida, for example, the two primary agencies with recovery responsibilities, the Corps and U.S. Department of the Interior, have different authorizing and appropriating committees, and EPA has still others. It is difficult to coordinate among authorizing committees—the Interior Department's committees introduce and pass bills as needed, whereas the Corps' Civil Works projects are committed to a 2-year cycle. The Agriculture Committee's budget flexibility is limited by the requirements of entitlement programs. There is a reluctance on the part of appropriators to fund other committees' accounts.

Future funding uncertainty. Lack of certainty about future funding bases makes interagency budgeting difficult. Under the current structure, efforts to secure multiyear funding for interagency proposals can be problematic. Due to changing agency and public priorities, there is no mechanism to guarantee long-term project funding. Accordingly, if one agency does not receive funds for a key component of a proposed joint project, the entire proposal can be jeopardized, frustrating interagency efforts to cooperate.

Limitations imposed by agency mandates. The degree to which agencies can collaborate on projects of mutual interest and provide joint funding for them is limited by agency mandates. Several agencies are limited to spending appropriations on activities within authorized physical boundaries. The Forest Service, for example, is limited in its ability to fund activities on private lands, even though activities such as research and monitoring provide valuable information to national forest managers. The Corps' various project purposes are generally spelled out in specific project authorizations and carry different nonfederal cost-sharing requirements. Adding new purposes to a project after it is authorized is thus legally and practically difficult. However, project authorizations can be modified via section 216 of the Rivers and Harbors Act of 1970 (P.L. 91-611), which authorizes the Chief of Engineers to "review the operation of completed projects . . . due to significantly changed physical or economic conditions and report to Congress with recommendations . . . for improving the environment in the overall public interest."

Staff reluctance. In interviews, federal agency employees indicated a degree of reluctance to initiate and/or adopt the increased interagency cooperation and interdisciplinary integration associated with the ecosystem approach. Although some managers are comfortable with taking the "risks" associated with new ways of doing things, others are not. Those uncomfortable with increased levels of interagency cooperation and those who perceive little incentive or lack of support at higher levels will be less likely to pursue interagency budget coordination. This may be less of a problem for agencies where senior-level managers have sent out clear directives and priorities to support the principles and practices of the ecosystem approach.

Lack of experience with nonfederal partners. Lack of staff experience and training in working with nonfederal partners is an obstacle to an effective ecosystem approach. Many agency staff members do not have the knowledge and experience necessary to involve nonfederal partners in decision making (see chapter on Public Participation). Lack of experience, together with concerns about restrictions on nonfederal involvement under the Federal Advisory Committee Act,

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will affect agency ability to involve nonfederal partners in the formulation of interagency ecosystem budgets.

Difficulties in transferring and pooling funds.

Difficulties in transferring funds among federal agencies were one of the budget constraints most often cited during survey team interviews. The ability to transfer funds varies greatly among and within agencies and departments. For example:

- The Forest Service and EPA may be able to transfer funds more easily than the Department of the Interior.
- It is easier for the Department of the Interior to transfer funds among its own agencies than to agencies in other federal departments.
- Forest Service Research units can transfer funds through cooperative agreements, whereas units in the Forest Service's National Forest System cannot so easily.

Identifying agencies that require increased flexibility in transferring funds, and determining the legal and/or administrative factors that create barriers to fund transfers, are important next steps in addressing this critical issue.

A related constraint faced by federal agencies endeavoring to establish regional interagency ecosystem offices comes from restrictions under section 612 of the Treasury and Postal Appropriations Act for FY 1995, P.L. 103-329. The Act prohibits interagency financing of "boards, commissions, councils, committees, or similar groups (whether or not they are interagency entities) which do not have a prior and specific statutory approval to receive financial support from more than one agency or instrumentality." The prohibition is broad enough to be virtually inescapable, unless there is specific authorization for interagency funding (such as that provided for the Council on Environmental Quality Management Fund).

Differences in agency budget structures.

Differences in budget structures among agencies can pose a barrier to coordinated interagency activities to implement the ecosystem approach. For example, although the Forest Service and Bureau of Land Management have similar land management program responsibilities, both have

very different account structures. Similar budget structures would facilitate better communication of budget priorities and programs within specific ecosystems as well as make interagency budget planning and execution easier to accomplish and understand.

Obstacles to Intra-Agency Reform

Federal agencies are instituting budget-related changes in order to facilitate the adoption of the ecosystem approach. However, in revising internal structures and procedures, they face a number of obstacles.

Traditional budget priorities. Agency budgets have traditionally been based upon previous funding history, ad hoc responses to crises, and (in some cases) commodities production (in the Bureau of Land Management and Forest Service, for example) or permit/enforcement requirements (in EPA, the Fish and Wildlife Service, and the National Marine Fisheries Service, for example). Although these factors must to some extent be considered when formulating budgets, the traditional exclusion of other factors, such as recreational and conservation values, is inimical to an ecosystem approach. Federal agencies have amassed a wealth of baseline social, economic, and ecological data that, if consolidated and analyzed, could provide additional information for determining priority needs, both nationwide and in specific ecosystems. However, these data are not sufficiently consolidated, accessible, or necessarily compatible (see chapter on Science and Information).

A related problem is that agencies are having difficulty placing priority on ecosystem-related activities approach while simultaneously coping with traditional resource-specific priorities and commitments. Determining which activities have highest funding priority and how they can be carried out under existing or (in some cases) growing funding constraints will take some time.

For some agencies, increased flexibility in setting funding priorities is constrained by additional factors. The Water Resources Council Principles and Guidelines, for example, are used by the Corps as an important tool for evaluating potential project options. Unfortunately, they place heavy emphasis on the National Economic Development Account and on screening project options largely on the

basis of their potential economic development benefits. Insufficient emphasis is placed on difficult-to-quantify environmental and social benefits, a constraint noted by interviewees in the Florida and Anacostia ecosystems.

The Interagency Floodplain Management Review Committee recommended reviewing the Water Resources Council Principles and Guidelines to establish two new, coequal objectives for water resources projects: supporting national economic development; and improving environmental quality (Interagency Floodplain Management Review Committee 1994, p. 85). It is understood that the Administration plans to reexamine the Principles and Guidelines.

Lag time between budget planning and execution. A significant lag time (1 1/2 to 2 years) between the start of the budget planning process and budget execution makes it difficult to anticipate exact funding needs for specific programs, to communicate changing priorities, and to shift funds to meet changing management and resource conditions.

Time limitations on use of funds. Time limitations on the use of funds can hinder agency investment in long-term activities. Appropriated funds must generally be spent within a 1- or 2-year timeframe. Long-term activities, such as ecosystem-related research efforts, often do not have guaranteed funding for the life of the project.

Narrow funding controls. Budgets traditionally comprise numerous narrowly defined line items. Existing budget structures for many agencies, including the Bureau of Land Management, EPA, and Forest Service, have evolved in response to resource management programs that parallel the interests of important constituent groups. Over the years, the number of budget accounts has increased, as has the specificity of each line item, which has discouraged managers from taking a broad interdisciplinary approach to managing within a geographic area. In FY 1994, for example, line officers in the Forest Service were responsible for up to 40 functional budget accounts. Agency efforts to reduce the number of line items (including the Forest Service's attempt to reduce line items in its fish and wildlife program) have met with resistance from external interest groups, who prefer more line items and increased functional fund controls.

Constraints to reprogramming funds. A successful ecosystem approach requires the ability for an agency to shift or reprogram funds in response to new information about the ecosystem and/or new input from other agencies or nonfederal parties. Historical concerns over accountability for expenditures have led Congress to establish reprogramming procedures that constrain agency ability to reprogram and respond quickly to changed conditions or unforeseen events.

For example, although the Forest Service succeeded in getting expanded reprogramming authority as part of its FY 1995 Budget Reform initiative, its authority to move funds between budget line items remains limited to \$3 million or 10 percent, whichever is less. The dollar cap makes this expanded authority difficult to manage and effectively prevents delegation of any new authority to field units. Similarly, EPA authority to move funds is limited to \$500,000, and movements of funds may be requested only twice per year.

Agency traditions also constrain reprogramming ability. In survey team interviews, some agency staff indicated a view of the ecosystem approach as a "new activity" to be funded with "new money," rather than as an approach to be integrated into existing activities and supported with existing funds. Staff with such attitudes are reluctant to shift funds from traditional activities to support a "new" ecosystem approach.

Uncertainty of future funding also makes agency staff reluctant to reprogram funds. For example, when two or more agencies fund duplicative programs, one may be reluctant to give up its program, for fear of losing the funds supporting it from its own funding base, or of sacrificing the activity altogether if the other agency's project is cut.

Congressional earmarking is yet another constraint to reprogramming of funds. Funds that are earmarked are locked into specific projects. Resources must be shifted from ongoing activities, which can disrupt comprehensive, ecologically based planning.

RECOMMENDATIONS

Federal agency ability to facilitate the ecosystem approach would be greatly enhanced if the following measures were taken:

- In every local and regional ecosystem where federal agencies take a joint ecosystem approach, establish mechanisms to increase coordination of budget planning and execution, to ensure that ecosystem budgets reflect an agreed-upon vision and strategic plans, and to ensure input by nonfederal stakeholders.
- At the national level, develop mechanisms for coordinating budget requests of the agencies involved in selected high-priority ecosystems, followed by coordination with congressional committees.
- Within each federal agency, develop budgets that reflect priority needs under the ecosystem approach, enhance budget structures to allow a flexible, interdisciplinary approach, and develop appropriate performance indicators.

Recommendations made below provide a starting point for implementing these measures. They are based upon considerable discussion, and on careful review of survey team studies. They include measures to be taken at the national level, as well as guidelines for agency efforts at the regional or local level.

Interagency Budget Teams

Interagency budget teams could be formed as a subset of the larger work group in each ecosystem where agencies are working towards a more integrated approach. Teams would ensure that federal agency budgets are designed and activities identified to reflect an established ecosystem strategy, and to increase agency coordination with other agencies and with nonfederal parties (including state and local governments and tribal entities) in identifying resource needs and priorities. In unusual cases, agencies may seek to integrate their ecosystem budgets.

A primary role of the teams would be to facilitate federal agency coordination on budget formulation. The degree and nature of coordination would vary somewhat from one ecosystem to another, depending upon the desired level of integration of agency activities and the history of agency coordination in the ecosystem. In some ecosystems, agencies may wish to coordinate by sharing planned budgets and

adjusting them to avoid duplication. In others, agencies may want to go beyond this and develop an interagency budget based upon a shared vision and strategy for the ecosystem.

Interagency budget teams would be faced with the challenge of developing a budget that does not rely on budget increases, but rather revises funding allocations within set budgetary targets. In ecosystems where interagency budgets are being developed, budget team members should try to go beyond a budget crosscut. Ideally, the budget should reflect complementary, coordinated activities based upon a shared vision and strategy for meeting the needs of the ecosystem.

High-Priority Ecosystems

A process should be established for selecting high-priority ecosystems, developing interagency budgets for these ecosystems, and devising a coordinated interagency strategy to justify these budgets to Congress. For some ecosystems, coordination at the regional level may be adequate to develop and support an interagency ecosystem approach. However, for ecosystems such as the Pacific Northwest and South Florida, where the resolution of conflicts requires intervention and/or support from higher levels, a more formal approach to interagency cooperation may be desirable.

A process for selecting such ecosystems should be instituted, and the process should allow sufficient time for interagency coordination. After high-priority ecosystems have been selected, budgets for them should be devised. Depending upon the nature and complexity of the ecosystem, formulating and developing these budgets may include:

- An interagency Memorandum of Understanding to establish the objectives, principles, and practices to be followed in specified ecosystems.
- A vision, measurable environmental goals, and a strategic plan for the ecosystem that accompanies an interagency budget request. The request should indicate how the budget of each agency would relate to the ecosystem. State, tribal, and other nonfederal parties could be involved in establishing resource needs and priorities. However, subsequent stages may be restricted to federal

agencies until the President's budget is presented to Congress.

- Each agency could incorporate its designated ecosystem activities into the normal agency budget formulation processes.
- Ecosystem budgets could be reexamined for ecosystem integrity by the ecosystem team following completion of the various agency processes.
- Interagency ecosystem budgets should be presented to the Office of Management and Budget, possibly by a designated lead agency for each ecosystem, together with overall agency budget requests (in September of each year).
- The Office of Management and Budget would be responsible for ensuring crosscutting budgetary review. Proposals for ecosystem funding would be evaluated on their merits and in light of the President's overall program.
- During final development of the President's budget, a special budget presentation could be prepared for each ecosystem budget, with input and review from all affected agencies.
- Coordinated letters could be sent to, and meetings held with, chairmen and ranking members of Subcommittees on Appropriations and/or Authorizations to inform them of joint planning and implementation efforts.

Interagency Transfers of Funds

Agencies should identify agency constraints to transferring or pooling funds and (where appropriate) to establish mechanisms for overcoming these constraints. In certain circumstances—that is, where agency missions or obligations to congressional committees are not violated—interagency fund transfers and/or a limited pooling of interagency funds can help facilitate interagency cooperation in such areas as research, analysis, and outreach, and in other activities related to the ecosystem approach. However, the ability of agencies to pool or transfer funds can be constrained by institutional or administrative barriers, many of which are specific to individual agencies.

Funding for Priority Ecosystem Needs

Within each federal agency, steps should be taken to ensure that budget allocations better reflect priority needs under the ecosystem approach, established in cooperation with stakeholders and in accordance with baseline data. The Clinton administration has accepted the ecosystem approach as an appropriate way of doing business. Federal managers should understand that the ecosystem approach is a philosophy that drives all natural resources programs and activities, old and new. Agency budget allocations should reflect this concept, and budget priorities should be adjusted accordingly.

An important step being taken by several agencies (including the Bureau of Land Management, Fish and Wildlife Service, Forest Service, and National Oceanic and Atmospheric Administration) is the revision of strategic plans to focus on goals under the ecosystem approach, and the gradual revision of budget priorities based upon strategic plans. Other agencies should consider this example. In addition, senior management should stress the importance of the ecosystem approach and provide guidance on how to ensure that budgets reflect this approach. Finally, a process should be established for increasing communication among scientists, managers, and budget staff, so that linkages between budget allocations and priority resource needs can be strengthened.

Budget Flexibility

Budget structures and processes should be enhanced to facilitate a more flexible, interdisciplinary approach. Specifically, federal agencies should take steps to:

- Seek to increase agency reprogramming authority. For agencies with severe reprogramming limits, authority could be requested, for example, for up to 15 percent automatic budget reallocation/reprogramming authority for each budget line item without prior congressional approval, with no dollar cap.
- Redefine budget line items and reduce their number (where appropriate).

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- Request that congressional Appropriations Committees make all accounts that support goals under the ecosystem approach no-year or multiyear funds.
- Increase the compatibility of agency budget structures. Agencies should explore options for compatible and consistent future budget structure modifications and/or displays for use in planning, presenting, executing, monitoring, and reporting budgets and budget-related information on an ecosystem basis.
- Review current Water Resources Council Principles and Guidelines to identify ways to better consider environmental benefits in choosing project alternatives for the Corps. This recommendation was made in a report by the Interagency Floodplain Management Review Committee (1994).

Better Performance Measures

Agencies should broaden efforts to increase accountability (both for internal purposes and for reporting to Congress) through the development of better performance measures. The development and continued refinement of performance measures will facilitate the process of adaptive management and assist federal agencies in communicating progress on ecosystem approach initiatives to Congress, interest groups, and the public.

Recently, Office of Management and Budget (OMB) Director Alice Rivlin instructed OMB analysts to "use performance information to inform or influence decisions whenever possible," stating that future budgets would give increasing attention to program performance measures. Federal agencies are responding to the requirements of the Government Performance and Results Act of 1993 by developing better performance measures. Agencies are beginning to coordinate these efforts, although cooperation among land management agencies and others taking an ecosystem approach should be broadened.

Examples of existing cooperation include Bureau of Land Management and Forest Service coordination in developing corporate performance measures (related to annual program proposals, reporting, and strategic planning goals). The Forest Service has been paired with the USDA Agricultural

Research Service in piloting annual performance plan development under the Government Performance and Results Act. The Forest Service, USDA Natural Resources Conservation Service (formerly Soil Conservation Service), and Bureau of Reclamation are sharing information on goals and measures related to the Act.

Specific efforts are also underway to develop new measures to communicate integrated resource management accomplishments on federal and other lands. For example, the Forest Service has developed new integrated resource inventory measures to facilitate implementation of the ecosystem approach, and to measure accomplishments associated with a new ecosystem planning, inventory, and monitoring budget line item. Forest Service Research is working with other agencies to develop measures of research accomplishment, including for research related to the ecosystem approach.

The U.S. State Department and the Forest Service are co-leaders for the United States in an international effort to develop criteria and indicators for sustainable forest management. Canada is providing the primary leadership for this effort, which involves many countries (Australia, Chile, China, Japan, New Zealand, Russia, and others), numerous private sector organizations (including the Food and Agriculture Organization, Global Forest Alliance, and National Association of State Foresters), and other federal departments and agencies (such as the Central Intelligence Agency, Department of the Interior, EPA, Federal Trade Commission, and National Biological Service).

Agency Mandate Review

Agency mandates should be analyzed to determine the extent to which they permit or impede the ecosystem approach. Agencies are sometimes constrained by overly narrow authorizations from cooperating in activities to implement the ecosystem approach (the Forest Service, for example, is restricted from performing broad-based assessments in areas including non-Forest Service lands).

New Ecosystem Approaches

New ecosystem approaches should be monitored and evaluated in terms of their cost-effectiveness

in attaining agency ecosystem objectives. Federal agencies should monitor and evaluate actions taken to implement the ecosystem approach in order to determine their cost-effectiveness and to

revise activities accordingly (for more specific recommendations on cost-effectiveness, see chapter on Science and Information).

Chapter 3: INSTITUTIONAL APPROACHES

The kind and quality of natural resource management depend on the structure and function of agencies charged with managing the nation's resources. Accordingly, the implementation of ecosystem approaches to natural resource management depends on the design and framework of agency institutions, and the way in which these institutions interface with natural resources. Some institutional structures support ecosystem approaches, and others do not.

In this chapter, we explore major barriers to, and opportunities for, implementation of the ecosystem approach that emerge from the institutional culture and structures of federal natural resource agencies. Our ability to utilize the ecosystem approach as a new approach to federal activities is predicated on the will and institutional arrangements to make it happen. This chapter identifies key institutional factors in successful ecosystem management, indicating their legal, regulatory, and budgetary implications (which are discussed in more detail elsewhere in this volume). To illustrate institutional issues, examples are used from case studies conducted by interagency survey teams in seven key ecosystems nationwide (see volume 3 of this series, Interagency Ecosystem Management Task Force 1995). At the end of this chapter, recommendations are made for institutional improvements to facilitate the ecosystem approach.

EMERGING INSTITUTIONAL ARRANGEMENTS

Institutional arrangements for an ecosystems approach to management are complicated by the multitude of overlapping political and geographic jurisdictions among the various federal and non-federal institutions in each ecosystem. These jurisdictions conform neither to ecosystem boundaries nor to each other. For example, the Southern Appalachians are a well-defined ecological region covered by a patchwork of jurisdictions, including parts of six states, various state and national parks and forests, parcels of forest industry land, and an array of local communities. Despite their diversity, different organizations in the region have established a mechanism for working together toward common goals under the Southern Appalachian Man and the Biosphere program.

Such institutional arrangements for managing ecosystems despite jurisdictional complexities are evolving as more is learned about interrelationships among environmental health, economic prosperity, and broad ecosystem approaches to natural resource management. Because the nation's economic and social well-being depends on the health of its natural resources and their continued availability to future generations, ecosystem approaches to natural resource management will receive increasing attention in the years to come. Institutional arrangements must remain flexible enough to address problems at hand and to integrate the multitude of stakeholder interests, whether governmental or private.

An ecosystem is an interconnected community of living things, including humans and the physical environment within which they interact. Ecosystems are not limited to rural areas: they encompass urban, suburban, and rural environments and all possible interconnections among them. An ecosystem approach must establish institutional arrangements that allow all stakeholders to participate in decisions made by political, economic, and natural resource management organizations in the ecosystem to assure that all concerns are appropriately addressed.

Types of organizations designed to address issues within a well-defined ecosystem are evolving. Many of the structures examined by survey teams are extremely successful. Federal land managers are beginning to utilize broader ecosystem approaches in collaboration with tribal, state, and local governmental units, as well as with private property owners. Federal agencies that provide technical assistance on nonfederal lands make data and information available to a wide array of private landowners and managers. State resource agencies maintain essential data bases on ecosystem interrelationships, as do such private organizations as The Nature Conservancy. Local governments as well as metropolitan and nonmetropolitan planning organizations maintain other data bases; increasingly, they are taking into account larger ecosystem considerations transcending their own boundaries. Private multijurisdictional organizations (such as the Alliance for the Chesapeake, a coalition of citizens, businesses, government

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officials, scientists, and farmers who act as a neutral forum to discuss, analyze, and encourage public involvement in policy making for the Chesapeake Bay; watershed associations; and other stewards of the land and water) have successfully brought stakeholders together. These voluntary stakeholder partnerships are important to the future of natural resource management.

INSTITUTIONAL ISSUES

Key factors essential to the ecosystem approach are linked to six main institutional issues:

- Shared vision and leadership
- Adaptive management
- Organizational structure
- Performance measures and accountability
- Information accessibility, usability, and communication
- Training and education

As each institutional issue is discussed below, linkages to other institutional issues are parenthetically indicated in italics (e.g., *Training*).

Shared Vision and Leadership

A first step under the ecosystem approach is to develop a vision for the ecosystem based on desired future conditions—what we want the ecosystem to look like and to produce. All parties who manage, influence, depend upon, and reside in the ecosystem, and who must live with decisions regarding it, should participate in developing the ecosystem vision. Leadership in the process of developing a vision for the ecosystem demands a broad approach transcending parochial interests.

Shared vision. Essential to the ecosystem approach is the ability to envision an overarching whole, and to identify the role one plays in it. Taking the individual point of view constrains understanding of the entire ecosystem, rendering problem-solving efforts inadequate. Still, there is a deep-seated reluctance on the part of many agencies and organizations to develop a shared vision, due to widespread belief that individual identity is lost in the process. Protecting “home turf” is a

common human response to perceived intrusions, potentiated for federal agencies by an operating system (see *Performance Measures*) that rewards with budget increases and new programs that enhance agencies’ capabilities at the expense of others. Parochial responses are equally common in longstanding organizations, such as the U.S. Department of Agriculture (USDA) Forest Service, and more recently established agencies, such as the Environmental Protection Agency (EPA). The problem is exacerbated by concentrations in each agency of employees with a special disciplinary focus: foresters in Forest Service, wildlife biologists in the U.S. Fish and Wildlife Service, and lawyers and engineers in EPA.

Agency missions have a powerful influence on the ability of federal employees to think beyond their often narrowly defined roles. The historical circumstances and conditions that led to an agency’s formation defined its mission for that time. But over time, the functional nature of agencies, reinforced by congressional direction, has led to barriers that have narrowed the parameters of thought and action. For example, the traditional fish-and-game focus of the Fish and Wildlife Service continues to influence management on national wildlife refuges, even though the agency has expanded its role to include management of endangered species. However, current natural resource issues are forcing agencies to push beyond traditional boundaries and to reassess agency missions, articulating a new vision for the future. Such factors as decreased fishery stocks, growing numbers of health advisories on shellfish and finfish consumption, degraded fish and wildlife habitats, rising numbers of endangered species, declining air and water quality, diminishing ground water supplies, and the need for cleanup of hazardous and toxic waste sites have triggered rising concern in federal agencies. In addressing these concerns, agencies have come to recognize the interrelationships among them, and to realize the need for holistic solutions to environmental problems. The ecosystem approach has emerged from this reassessment, both within and across agencies.

Engaging agency employees in defining agency visions and missions is gaining acceptance as a management tool. In the process, it is critical that everyone be equal—that every participant be made to feel that his or her thinking is worthy of consideration. This approach was pioneered by the U.S. Army Corps of Engineers (Corps) at Senior

Leadership Conferences for years, the Bureau of Land Management at its 1994 Nevada summit, the Forest Service at its 1994 Houston leadership conference, and the USDA Natural Resources Conservation Service (formerly Soil Conservation Service) in 1991. In each case, the agency brought together its entire leadership to discuss its changing mission and what its role will be as natural resource agency in the 21st century.

The issue can be summarized as follows:

- Agency missions can lead to conflicting visions, perpetuated through programs that function in a "stovepipe" (or strictly vertical) manner.
- Both within and between agencies, there is lack of thinking in terms of broad systems. Accordingly, there are no shared visions for ecosystems and no common goals under the ecosystem approach, resulting in inconsistent settings of agency policy.
- The legislative mandate for some agencies makes them reactive in nature and less able to deal with emerging issues. The result is that symptoms are treated rather than the root cause of the problem—there is no "preventive medicine."
- There is resistance to change—and comfort with the status quo.

Shared leadership. Even though different agencies may use different words to describe an ecological approach to natural resource management, the underlying concepts are the same. The principles and guidelines for the ecosystem approach developed in volume 1 of this series (Interagency Ecosystem Management Task Force 1995) can provide a common framework within which each agency can articulate its unique role.

The next step is to identify roles in each ecosystem and to enable the appropriate agency or organization to provide leadership in interagency efforts to implement the ecosystem approach. In many areas, several agencies are able to provide the information base for natural resource management and could share expertise and leadership. But will ego allow leadership to be shared? Equally importantly, does the current reward system (see *Performance Measures*) encourage us

to share leadership? Finally, will managers learn to share authority? Leadership does not mean being "top dog," but rather showing the way through actions that lead others to want to participate. The move toward consensus-building in government, reflecting changing attitudes among federal managers, provides a major impetus in this direction.

Examples. Citizens and public officials in the 35 communities that cover the Charles River watershed in Massachusetts developed a shared vision for the watershed, based upon wetland acquisition as the preferred means of flood control. The Corps had recommended that the last 10 miles of river be put in a concrete channel to control periodic flooding, primarily in the Boston metropolitan area. In cooperation with public officials and others, the Corps identified the need for hydrological studies that finally affirmed that the wetland approach was a feasible and economical alternative to channelization. The wetland approach cost \$17 million, compared to \$30 million for the proposed channelization (in mid-1960 dollars). Saving the wetlands produced additional benefits, including maintenance of ground water levels for municipal well supplies. The flood control controversy resulted in formation of the Charles River Watershed Association in 1965. The association has successfully monitored water quality and promoted recreational activities throughout the watershed. A planning process is now being initiated to address water supply and other needs as the watershed deals with the impact of further urban growth.

Experiences in the Anacostia River watershed illustrate the need for co-leadership by major governing bodies in an ecosystem and for sharing of information to contribute to a common vision. Through a federal and state partnership early in the planning stages, many problems that have occurred could have been avoided, such as difficulties in obtaining Clean Water Act section 404 permits for ecosystem restoration projects. The Metropolitan Washington Council of Governments played a key role in helping to integrate urban planning concerns with natural resource planning, and in providing technical expertise on an intergovernmental basis encompassing the entire watershed. The survey team concluded that the Anacostia Watershed Restoration Committee's Six-Point Action Plan provides focus, but is not comprehensive enough, failing to include federal efforts until 1991. However, it remains an effective mechanism for

developing a shared vision for watershed restoration.

The bottom-up approach is exemplified in both Coastal Louisiana and the Great Lakes basin. In the latter, the common goal—based on a shared vision—is established through the Great Lakes Water Quality Agreement. Under the umbrella of this agreement, local goals are established through Remedial Action Plans involving agencies, citizens, and stakeholder groups, realizing the vision on a practical level. A similar process was developed for Coastal Louisiana through establishment in 1980 of the Coalition to Restore Coastal Louisiana, which led in 1990 to enactment of the Coastal Wetland Planning, Protection and Restoration Act.

In the Pacific Northwest, the interagency survey team found that development of a shared vision for the future was mentioned most frequently as an essential ingredient to the success of ecosystem-based management. Unlike several other ecosystems studied by survey teams, the Pacific Northwest had seen no organized effort to consider the entire region until development of the President's Forest Plan in 1993. Until then, the area was known for conflict among agencies and organizations, not for interagency cooperation. Efforts tied to Forest Plan implementation are helping to develop a shared vision for the ecosystem, although the litigation-driven process in this region reflects the weaknesses of any top-down directive (weaknesses avoided in bottom-up approaches based on mutual agreement to cooperate). Similarly, until the *Exxon Valdez* oil spill emergency, cooperation in Alaska's Prince William Sound was limited to the local level and focused on discrete projects rather than addressing the entire ecosystem.

Adaptive Management

Adaptive management is an iterative approach to decision making involving a cycle of planning, implementation, monitoring, research, and subsequent reexamination of management decisions based on new information that may alter existing plans and priorities. Adaptive management necessarily cuts across ecosystem management issues, including budget issues (such as funding for monitoring), institutional issues (such as guidelines for decision-making processes), science and information issues (such as access to applicable

and reliable scientific information), and legal issues (such as statutes that hinder or facilitate adaptive processes). (For further discussion of the role of science in adaptive management, see chapter 5.)

Approaches. An adaptive approach recognizes that ecosystems are inherently changing and unpredictable. Long-term management of such multifaceted systems requires an ability to evaluate present and future management choices based on past results. The ecosystem approach and sustainable development involve decision making based on the recognition that all information needed for complete evaluation of alternatives may not be available. Adaptive management is an iterative process of learning from past experience and applying the lessons learned to current decision making in order to implement management practices under changing and often uncertain conditions. Acknowledgment of uncertainties in the decision-making process is at the heart of the ecosystem approach. Adaptive management copes with these uncertainties by monitoring decision-making results and reexamining choices in light of these results and of new information that becomes available.

In its simplest form, adaptive management is a process made up of a series of feedback loops that provide managers with information on results of past management decisions and on present conditions. The intent is to help managers assess the impact of past actions on current decision-making options. Unfortunately, an adaptive approach to decision making has not been implemented as broadly and frequently as possible, in part because (1) the information feedback loops on which the process depends may not exist, (2) existing feedback loops may be easily obstructed, (3) existing feedback loops may not provide useful information, (4) agencies may not be willing to reevaluate management decisions with the available information or necessary frequency, and /or (5) no (or very limited) budgets are provided for the monitoring required for adaptive management. In some cases, legal requirements related to the decision-making process (for example, requirements of the National Environmental Policy Act) have been perceived as barriers to an adaptive approach. In addition, there is confusion and apprehension about who should be involved in management decisions at ecosystem scales in the first place, and how and when decisions should be made. This has further

complicated questions about who should be involved in monitoring, assessment, and possible reevaluation of management choices in the future, and how and when these processes should occur. Finally, many managers may not adequately understand the adaptive management process or how to use it as a management tool (see *Training*).

Participants in survey team interviews and in regional and watershed management efforts recognized that (1) management decisions must be made with the best information possible, (2) monitoring programs should be in place to collect data for assessment of results of these decisions, and (3) the management process must involve reevaluation of management practices and future decisions based on past results and new information. It is hoped that implementation of these basic steps of adaptive management will set in motion an iterative process providing the opportunity to learn from our experiences and refine our ability to manage from a sustainable ecosystem perspective and to improve the certainty and effectiveness of our actions.

The information feedback loop essential to adaptive management is implemented in four steps:

- Monitoring programs are designed to collect data on results of management decisions.
- Monitoring programs are implemented.
- A process is established for making monitoring data accessible to future decision makers and to those doing future monitoring. This process is designed to assure that information collected is useful in assessing the results of past management actions, and that it is of the type and in a form useful to decision makers.
- Monitoring information is used to evaluate results of past actions so that future decisions are not made without taking into account lessons learned.

Two of the most difficult problems at this final stage are deciding how often to make these evaluations, and determining what new information should compel an adjustment to management strategy. What threshold should trigger an adjustment? Who decides when and how to make adjustments? What are the definitions and

thresholds of acceptable results? These questions must be addressed in implementing an adaptive approach to decision making.

Examples. In Coastal Louisiana, the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) established an interagency task force to coordinate restoration efforts. The Act stipulated that funds for long-term monitoring of restoration efforts and results had to be planned into project budgets. Because adaptive management requires monitoring of management actions to determine results of past decisions, its success depends on adequate monitoring. Unfortunately, monitoring is frequently one of the first casualties of budget tightening, and even when funding remains, monitoring programs may not be designed carefully enough to provide information of the kind or in the form most useful for evaluating past actions and aiding in future decision making.

The CWPPRA process requires that 5 percent of funding for each coastal wetland restoration project go to monitoring of results for 10 years. Because monitoring is so essential to adaptive management, participants in the CWPPRA process regarded this measure as a very positive step toward institutionalizing funding for monitoring. After funds were provided, questions remaining were how well the monitoring programs were designed, whether they would provide the information needed to make wise management decisions in the future, and how and when this information would be made available to help evaluate management decisions. Currently, state agencies assume most responsibility for monitoring CWPPRA projects. In the future, federal agencies and universities are expected to participate in monitoring and information transfer to provide greater closure to this promising adaptive management feedback loop in the Coastal Louisiana ecosystem.

In the Great Lakes basin, the monitoring program established by the Lakeside Management Plan for Lake Michigan was highlighted by interviewees as a successful example of collaborative monitoring by several state and federal agencies. Common monitoring goals were established among agencies, and current monitoring efforts were measured against them to identify gaps and overlaps in monitoring coverage. Monitoring efforts were then shifted to reduce overlap and make resources available for coverage of unmonitored areas. This

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process allowed criteria to be developed for shifting monitoring efforts on temporal, spatial, and topical bases to provide the most efficient coverage during changing seasonal conditions. Funds for monitoring were not pooled; instead, agencies agree to fund and implement monitoring activities related to their missions and programs in order to cover the range of variables or regions requiring attention. The result was a reduction in overlap and more efficient distribution of monitoring efforts, producing a more comprehensive information base for use in the adaptive management process. Saginaw Bay and other areas in the Great Lakes basin developed similarly successful monitoring programs.

Adaptive management has been the subject of extensive discussion in the Pacific Northwest. An interdisciplinary Forest Ecosystem Management Assessment Team of biologists, ecologists, economists, sociologists, and others developed a general planning model that illustrates the adaptive approach to ecosystem management (Forest Ecosystem Management Assessment Team 1993). The interagency organizational structure created to implement an ecosystem approach in the Pacific Northwest illustrates one way of addressing questions on how to implement adaptive management. Several coordination groups, including the Interagency Steering Committee, Regional Interagency Executive Committee, and a Regional Ecosystem Office, were created by a Memorandum of Understanding for Forest Ecosystem Management, which establishes a formal procedure for interagency coordination. These groups provide a framework for addressing when and how new information may affect management plans and practices. The Regional Ecosystem Office in particular is responsible for evaluation of major modifications arising from the adaptive management process as well as for formulation and implementation of data standards. The Office has no decision-making authority, but rather makes recommendations to the Regional Interagency Executive Committee, which is responsible for implementing Interagency Steering Committee directives.

Monitoring and information transfer components of an adaptive management feedback process are a focal point of restoration efforts in the Prince William Sound ecosystem. Although implementing the ecosystem approach was not one of the primary purposes for establishing the *Exxon Valdez* Oil Spill Trustee Council, it is one of the basic

policies set forth in the Council's plan for restoring resources in Prince William Sound following the oil spill. The plan emphasizes not only restoration and habitat protection, but also the research and monitoring needed to produce broad-based information on how the Prince William Sound ecosystem functions. This information is crucial for future management of resources and assessment of environmental impacts.

Efforts are underway to ensure that information from monitoring and research is made available as quickly and efficiently as possible to a broad range of interested parties. The Trustee Council established an Oil Spill Information Center to lead these efforts and to function as a repository for information generated during cleanup, damage assessment, and restoration efforts. Electronic information-sharing projects currently being planned or implemented emphasize making information more accessible rather than defining common data reporting formats. Immediately after the oil spill, litigation prevented access to much data and severed the feedback loop necessary for adaptive management. However, current efforts to make data accessible and responsive to a broad range of managers and stakeholders hold great promise.

Such efforts are clearly facilitated by the substantial funds available from court settlements for restoration of Prince William Sound. Some of these funds will be set aside in a long-term reserve for future projects as new needs and goals become apparent. This long-term reserve, which will include funds for future research, sets aside money for future use without specifying how it will be spent.

In the Southern Appalachian region, many groups are trying to find ways to integrate a more adaptive management process into their activities. Operating regulations for many agencies do not permit quick adaptation to changing conditions (such as realignment of funds, staff, and policies). Although it is often desirable to have one agency take the lead in certain areas and direct expenditure of pooled funds, administrative procedures make it difficult to transfer funds from one agency to another.

One measure facilitating adaptive management in the Southern Appalachians is use of an ad hoc committee to deal with a sudden outbreak of the dogwood anthracnose disease, a specific problem

that crossed agency jurisdictions and required immediate attention. Survey participants noted that it was difficult to get funds and staff focused on this problem, which hit the entire region very quickly. Administrative procedures made it difficult to transfer money to one lead agency when needed by another. The ad hoc committee was formed as an independent body that could cooperatively assign tasks, readily share data and information, and continue to develop a strategy for dealing with the disease.

Organizational Structure

For the federal government to implement the ecosystem approach nationwide, the hurdles presented by its organizational structure must be overcome. Organizational structure presents barriers to communication, coordination, interdisciplinary hiring and training, ecosystem budgeting, and public participation. Agency structure is interconnected with other institutional barriers to the ecosystem approach, including those pertaining to shared vision and leadership, performance measurement and accountability, and training and education. Performance within the organization is naturally oriented to the structure and mission of the agency (see *Shared Vision*).

Structural barriers. Some agencies (such as EPA) were set up to handle a specific mission, and others (such as the U.S. Department of Housing and Urban Development) were designed to deal with a group of closely related needs. Federal agencies are authorized by specific legislation and budget authority to pursue particular missions. The narrow agency focus that often results does not conform to the interdisciplinary, collaborative, cooperative nature of the ecosystem approach and impedes the sharing of a vision across office or agency boundaries. Moreover, the organizational subunits of an agency have even more narrowly defined roles or missions. These structural barriers are reinforced by agency accountability before Congress: agencies, and even subunits of agencies, are accountable to different congressional authorizing and appropriations committees, and particular issues often fall under the jurisdiction of many committees with varied concerns.

The budget process directly reinforces the organizational status quo by creating competition among offices and agencies for funding, especially in times of tight or shrinking budgets. Agency and

departmental guidance is reinforced by the Office of Management and Budget, which reviews agency budgets in a functional, nonintegrative manner. This competition can create a zero-sum game, where any change in program direction or funding can lead to losses in programs or personnel, and thereby to loss of influence and status within the culture. All of this is inimical to the shared vision and collaborative efforts needed to implement the ecosystem approach.

The isolation of agency subunits from one another leads to poor communication. It is not uncommon for multiple environmental impact statements to be filed for individual agency actions, even though the activities occur in the same region or even at the same site. This lack of coordination can lead to missed opportunities for cooperation in activities important to the ecosystem, or for mitigation of environmental impacts. Separate studies may be redundant, and can become quite expensive. However, some sites and agencies are developing programmatic environmental impact statements to deal with these issues.

Agency structure may pose a barrier to public communication by baffling citizens who seek environmental information or coordination and funding for ecosystem-related activities. Often, parties outside (and even within) the federal government cannot find out where to go or whom to contact. The difficulty may be compounded as agency boundaries blur with the move to an interagency ecosystems approach to natural resource management (see *Information Accessibility*).

The structure and mission of an agency determine its skills mix, which may be inadequate in certain disciplines for the needs of the ecosystem approach. Typically, an agency will hire specialists needed to fulfill its narrowly defined mission, in addition to the support personnel required to make a bureaucracy work. For most agencies, however, the need for systematists or generalists was not often envisioned when the agency mission was defined. For example, the negotiation skills critical to attaining consensus on contentious issues are not usually part of the toolkit the scientist or manager brings to the job (see *Training*).

Land boundaries and jurisdictional differences among agencies also create structural barriers to an ecosystem approach. Moreover, agencies use several valid but quite different systems for

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classifying ecosystems in the United States (see chapter on Science and Information in this volume). Finally, most agencies have geographically defined subunits, which tend to develop their own objectives and "missions," and their jurisdictional boundaries rarely coincide with ecosystem boundaries. Implementation of the ecosystem approach will require use of natural and changing boundaries, with cooperation among artificially defined subunits. In an attempt to address these barriers, the Bureau of Land Management, Forest Service, and Natural Resources Conservation Service are developing a common map of ecological units to facilitate communication and coordination in regions of mutual interest and authority.

The issue can be summarized as follows:

- Agencies are mission-oriented, with a narrow internal focus. The lack of a systems approach to management generates difficulties in communication and coordination, impeding an ecosystem approach.
- Obstacles to the ecosystem approach presented by organizational structure include narrow focus in planning and policy, orientation toward a single discipline in hiring and training, nonsystems-oriented budgeting, and competition for budget allocations.
- Agencies and organizations use different jurisdictional boundaries, acquiring their own objectives and "missions" within those boundaries, even within the same agency. Jurisdictional boundaries rarely coincide with ecosystem boundaries.
- Agency culture and traditions are both the strength and weakness of organizations. They elicit institutional loyalty and solidarity, but also unwillingness to change.

In a pilot project, the Forest Service found that 70 percent of its regulatory barriers were self-imposed rather than required by legislation. Although legislation is often cited by both employees and management as a barrier to interagency coordination, it usually inhibits interorganizational cooperation rather than prohibiting it (Office of the Vice President 1993, p. 11).

Examples. In practice, many organizational barriers can be overcome. For example, federal wetlands regulation proved unacceptable to many interested parties (landowners, federal regulators, commercial interests, state and local governments, and others), but each party was dissatisfied for a different reason. Their conflicting viewpoints produced gridlock, preventing any major changes to federal wetlands policy since the 1977 Clean Water Act amendments. In June 1993, vowing to break the gridlock, the Clinton administration convened the Interagency Working Group on Federal Wetlands Policy. Chaired by the Office on Environmental Policy, the group included participants from nine agencies. It sought the views of all sides, including members of Congress, representatives of state and local governments, environmentalists, developers, agricultural interests, and scientists. The group then identified the major issues to be addressed, wrote options papers, and decided on policy positions. A report was issued in August 1993. The group then worked with Congress on legislative language for initiatives requiring legislation. Federal agencies have begun the process of developing appropriate regulations and implementing nonregulatory actions.

The U.S. Department of Energy provides an example of organizational barriers to a collaborative ecosystem approach embedded in agency structure. In the Department of Energy, separate offices are responsible for lands, facilities operations, cleanup activities, economic development projects, environmental research parks, public participation, and other activities. A welter of mission priorities for the Department and its individual offices has overwhelmed the organization.

Recognizing these structural barriers, the Department of Energy is pursuing ways of overcoming them within the department. Enthusiastic work at the staff level, and innovative, imaginative leadership by some office managers and by the Secretary's office are moving the department toward a solution. The Department is developing collaborative, integrated planning for land and facilities management, a process that incorporates principles of the ecosystem approach in the form of requirements to be met. Department planning for land and facilities operations will take into account the needs and desires of local communities, integrating them into the Department's

mission in accordance with the needs of the nation to ensure continued ecosystem health. This integrated policy builds upon many disparate initiatives within the department.

The Coastal Louisiana survey team study illustrates the value to federal agencies of traditional missions and patterns of organization. The team found that traditional roles help to clarify where centers of expertise lie, and to foster the *esprit de corps* necessary to retain the valued employees and institutional knowledge needed to effect long-term management. Preserving traditional roles helps to identify where gaps in expertise lie.

The Great Lakes survey team study uses the term "institutional ecosystem" to describe the cooperative and collaborative organizational structure that has been put together (along with partnerships with industry and private citizens) to manage the Great Lakes ecosystem. This structure is based on recognition of the fact that sustainable development in the Great Lakes basin depends on taking a holistic approach to natural resources: resources must be seen not as distinct elements, but rather as parts of dynamic and interdependent communities and ecosystems. Taking an ecosystem approach means that all partners—government and private-sector alike—must understand the implications of their actions and strive to avoid unintended adverse effects on the environment.

The Pacific Northwest survey team study found that the Intergovernmental Personnel Act of 1970 provides a useful tool for overcoming organizational barriers. Under the Act's provisions, the experts needed to implement the ecosystem approach can be drawn from multiple agencies and offices and located in a single office. The Prince William Sound survey team study noted an additional factor needed for success: the regional coordinating body in the Prince William Sound ecosystem was able to hire a full-time staff, including a director and scientists, contributing to its success. Because staff members owed allegiance to no particular agency, they were able to facilitate consensus building within the decision-making body.

Performance Measures and Accountability

Performance measurement and accountability link ecosystem goals to actual changes in public and

private behavior that enhance ecosystem health. Performance accountability provides the framework for measuring program and policy outcomes against a common standard and organizes information for effective use by all stakeholders.

Requirements and barriers. Performance outcomes fall into two broad categories: accountability related to agency and employee actions, and accountability related to ecosystem functions. The ecosystem approach is seriously impeded when performance measures are missing, and when there are no corresponding incentives to encourage ecosystem management and coordination at the federal, departmental, agency, subunit, and employee level. Implementation of the ecosystem approach requires a set of universally accepted ecosystem health indicators. Without them, collaboration among federal and nonfederal stakeholders is difficult, and programs and projects may work at cross-purposes, sending conflicting signals to landowners and resource managers.

At the administrative level, the federal government must measure the performance of agencies that directly or indirectly affect ecosystems in their activities. The Government Performance and Results Act of 1993 set forth new standards for measuring the performance of government agencies. The Act requires federal agencies to develop measurable objectives for selected programs. Several agencies have been asked to create pilot programs that emphasize this approach in budget acquisition. In general, the federal performance accountability incentive system should be changed to encourage the following:

- Collaborative efforts among agencies and with nongovernmental organizations and individuals.
- Sharing of information among stakeholders.
- Empowerment and increased responsibility at the local level.
- Coordination of agency budgets.
- Creation of incentives for private citizens.
- Legislation that supports balancing a variety of ecosystem functions rather than sheer commodity outputs.

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- Measurement of ecosystem health outcomes rather than inputs.
- Incorporating ecosystem approaches into program objectives.
- Building partnerships.
- Ensuring environmental justice.

At the ecosystem level, without a set of clearly defined, scientifically sound, field-tested indicators, measurable success under the ecosystem approach is problematic. Ecosystem health indicators serve two prominent roles in the ecosystem approach: first, they provide concrete guidance to practitioners, landowners, and other stakeholders, enabling them to determine jointly when goals of environmental protection and sustainable production have been achieved; and second, they serve as proxies for complex, often poorly understood processes that depend on numerous variables and functions involved in the ecosystem approach.

Without ecosystem health indicators, measurement of public and private performance in environmental protection is difficult: in some cases, no measures are available, and in others, different groups use different measures. Use of common indicators encourages better communication, reduces conflicts, and accelerates program implementation. Ecosystem health indicators help to ensure that all federal initiatives are based on national standards, that resource concerns are not ignored, that problems are more clearly defined, and that the public is given consistent recommendations.

Specific barriers to establishing performance accountability include:

- Lack of criteria or standards for determining whether objectives under the ecosystem approach have been met.
- Lack of methods consistently employed across agencies for evaluating agency and interagency performance in accomplishing objectives under the ecosystem approach. The focus continues to be on inputs and outputs rather than outcomes within a systems context.
- Lack of a reward system for recognizing accomplishments in interagency ecosystem

collaboration and outcomes. This includes appropriate acknowledgment of research, technology assistance, and management accomplishments reflecting interagency or interdisciplinary approaches.

Examples. There are many specific instances where performance measurement and accountability could encourage government and private efforts to improve ecosystem health. In the Pacific Northwest, for example, inconsistencies in various land management statutes have impeded coordinated land management planning and made it difficult to establish performance accountability measures that are consistent across agencies. Specifically, prior Administrations assumed that differences between the Oregon and California Revested Lands Act (governing some Bureau of Land Management lands) and the National Forest Management Act (governing Forest Service lands) made consistent standards impossible. However, appropriate incentives could lead to cooperation between the agencies and more rational land management standards.

The line-item (or program) budget model further illustrates how the ecosystem approach is affected by a performance accountability system. For example, the Forest Service and Bureau of Land Management lack the budgetary flexibility needed to meet ecosystem management challenges as they arise. Both agencies use budget line items by program, leading to conflicts among programs. The Forest Service practice of tying budgets to a single resource or function also creates problems: as timber sales decline, agency budgets decrease, despite a growing need to pursue conservation, restoration, and other nontimber objectives in managing the national forests. Linking Forest Service budget levels to an ecosystem-based performance accountability system rather than to the single function of timber production could help solve this particular problem. Current activities in response to the Government Performance and Results Act are defining new outcome-oriented performance measures.

Ecosystem-wide coordination among federal agencies is hampered by disparate agency missions (see *Shared Vision*) and separate, lengthy planning requirements, all rooted by statute in the federal land management framework. For example, in the greater Yellowstone area, adjacent National Park Service and Forest Service lands in the same

ecosystem have been managed with very different objectives, in part due to funding incentives for Forest Service timber harvesting. A performance accountability system could be devised to allow consistent management across the entire ecosystem, either under current authorities or by providing direction in regulatory amendments.

In October 1993, a workshop at Yale University on the ecosystem approach found numerous barriers to building effective partnerships across ownership boundaries. Participants concluded that federal land management agencies, together with federal, state, and local regulatory agencies and tax authorities, often operate in ways that do not support the ecosystem approach, and in many cases impede it. Often, private landowners do not establish desired ecological conditions in an area because there are no incentives for them to do so. Specifically, federal and state income and inheritance taxes and regulatory provisions do not generally distinguish between landowners who go to considerable expense to achieve federally identified ecological goals and those who do not. Not only are technical and financial assistance inadequate, there are not enough market-based approaches to solving problems. A performance measurement and accountability system that monitored and rewarded formation of ecosystem-wide partnerships, involvement of private landowners in the ecosystem approach, and modification of private sector incentives would considerably enhance ecosystem health.

Problems with the New York City water supply illustrate how lack of performance accountability measures and incentives to reward coordination can impede implementation of management plans. In 1990, New York City issued a discussion draft of revisions to its watershed regulations as part of the New York State Public Health Law. The draft regulations limited runoff from pastures, prohibited discharge of contaminants from barnyards, and proscribed application of manure and fertilizer within "limiting distance" of a watercourse. The agricultural community maintained that the proposed regulations threatened the viability of farming. Because New York City believed that agriculture was the preferred long-term land use, it established an ad hoc task force to recommend programs and regulations to protect the New York City water supply while sustaining agriculture. As a result of the task force's efforts, the city adopted a Whole Farm Planning approach based on community planning principles. This approach will be

reviewed in 1997, and if Whole Farm Planning is not adequately protecting the water supply, the watershed communities and the city have agreed to use alternative measures, including regulations.

In urbanizing areas, however, permits for new houses and businesses were severely limited, a solution unacceptable to local communities, which challenged New York City's control over development in court. Putnam County estimates that the regulations would cost it 3,190 jobs and increase taxes by 16 percent by the year 2000. In this case, there was little of the systemwide coordination evident in the city's approach to the agricultural sector: *Adaptive Management* principles were not employed, *Organizational Structure* was ignored, *Performance Measures* were not established, and there was no *Shared Vision*. Performance accountability criteria at the state and local level could have helped to ensure that the urban component of the watershed plan would have been implemented more effectively and efficiently.

The South Florida survey team found that agricultural support and flood insurance programs were thought to exacerbate the Everglades' environmental decline. Specifically, USDA sugar price supports and import restrictions promote sugar production in environmentally sensitive areas, and the National Flood Insurance Act encourages development in environmentally sensitive areas. The team noted the need for broadening agency coordination to cope with these and other problems. Here again, performance accountability measures designed to coordinate programs across agencies could substantially enhance ecosystem health.

Other survey team studies also revealed deficiencies in performance accountability in accomplishing resource management objectives. The Pacific Northwest survey team noted that agency budget and appropriations processes reflect a long history of rewarding commodity production at the expense of conservation activities. The Coastal Louisiana survey team found that wetland restoration could be enhanced through consensus on a set of ecosystem health indicators, and the Southern Appalachian survey team concluded that federal agencies spend resources on projects that conflict with one another. However, it is clear that increased emphasis on ecosystem sustainability, including sustainability of the human community, is redefining performance objectives for all agencies.

Information Accessibility, Usability, and Communication

Implementing an ecosystems approach to management requires an understanding of how ecosystems function, together with an awareness of resources in each particular ecosystem, their interactive processes, and threats to the ecosystem as a whole. However, our ability to understand how ecosystems function is restricted by lack of data and models, limited access to existing data because of technical and administrative barriers, and lack of expertise in interpreting existing information. Similar problems obstruct our understanding of particular ecosystems; and the fostering of partnerships is impeded by poor flow of communication, especially on a peer-to-peer level between partner organizations.

Needs and constraints. Provision of information is the point where nature, science, policy, politics, and public involvement intersect. Therefore, information must be accessible across agency boundaries and to the public. For stakeholders to reach an enduring consensus on management strategies, they must have access to empowering information, and information sets must be compatible so that they can be appropriately integrated, analyzed, and understood. Information accessibility is not an end in itself, but rather a means to foster interagency cooperation and public empowerment, support the design of measurable performance criteria, assist in defining training needs, and facilitate adaptive management.

Important keys to information accessibility include development of standard data protocols and creation of ways to integrate information through techniques such as geographic information systems and network technologies (including Gopher, Mosaic/World Wide Web, and Wide Area Information Servers). Significant barriers to information accessibility and usability and to the free flow of communication include the following:

- Many personnel lack the proper procedures, training, and experience needed to efficiently, effectively, and economically gather, interpret, analyze, and use information.
- It is difficult, expensive, and time-consuming to acquire, understand, and use data from multiple external sources.

- Frequently, data quality is poor or unknown, and/or data were not collected with secondary uses in mind.
- Collectively, we lack awareness of who has what information, how existing data can be used, and how to make information available within agencies, across agency lines, and to the public.
- There are major gaps in our information about ecosystems.
- Existing valuable data may be lost for many reasons, including departure of the data collector, changes in technology, lack of publication, or lack of support for maintaining data collections (creating “orphan data sets”—what Vice President Gore calls “data rotting in silos”).
- Some data are sensitive (such as exact nesting sites or locations of endangered plant populations), proprietary, or subject to privacy.
- The public and government employees have neither a shared vision and understanding of what the ecosystem approach is and means, nor flexible mechanisms for sharing ideas or asking and answering questions.

Examples. Electronic information networking is a rapidly evolving means of improving our capabilities to meet the needs of ecosystem-based management. Dramatic changes are occurring in our ability to access and use information and to communicate with each other. Vice President Gore has been a national leader in the initiative to create the National Information Infrastructure, also known as the “information superhighway.” The National Information Infrastructure is now being thought of as the U.S. component of a global information infrastructure. The media refer constantly to the information highway, and jokes about “roadkill,” “gridlock,” and “toll booths” abound—a sure sign that the concept is pervasive. Internet, the federally established information network designed as precursor to a full National Information Infrastructure, has more than 20 million users and is growing at the incredible rate of about 10 percent per month.

The Administration has created the Information Infrastructure Task Force, which has identified environmental information empowerment as a key area of potential application for the National Information Infrastructure. The National Performance Review has created a "NetResults" program that is building interagency electronic networks to facilitate implementation of National Performance Review recommendations. Electronic mail is increasingly used in federal and many state agencies to share information, ask and answer questions, and identify collaborative opportunities.

Researchers have built new tools (foremost among them Gopher, Mosaic/World Wide Web, and Wide Area Information Servers) that make it relatively easy for suppliers to publish and customers to find, access, and use information over Internet. The Fish and Wildlife Service has placed the National Wetlands Inventory and lists of threatened and endangered species on information servers on Internet, where they are accessible to millions of users, including thousands of agency employees. Pilot interagency networks for the ecosystem approach have been built for the Gulf of Mexico, the Great Plains, the Great Lakes, and elsewhere. The National Performance Review's NetResults team has built about 10 interagency networks and endorsed the creation of a new network to support the ecosystem approach.

Vice President Gore has begun the Global Learning and Observations to Benefit the Environment initiative, under which thousands of schoolchildren will collect standard environmental data sets and share the information over Internet. This initiative would help to educate and engage people in ecosystem studies, and could conceivably collect information useful to natural resource managers. The U.S. Geological Survey is leading development of a National Spatial Data Infrastructure designed to provide essential spatial data sets needed under the ecosystem approach, and the National Biological Service is leading creation of a National Biological Information Infrastructure. The Office of Management and Budget and the Smithsonian Institution have proposed establishment of a National Biodiversity Information Center. The National Aeronautics and Space Administration is building the Global Change Data and Information System, which will help provide access to relevant data. The National Science and Technology Council's Committee on Environment and Natural Resources has created an Observations and Data

Management Task Force to help coordinate interagency efforts.

On the international front, the Australians have shown global leadership with their Environmental Resources Information Network, which provides Internet access to key national data sets needed to understand and manage ecosystems. The Biodiversity Information Network in Brazil has built an international consortium of researchers and managers cooperating to exchange information to support Biodiversity conservation. And the World Conservation Monitoring Center in the United Kingdom has emerged as another international leader.

In the Southern Appalachians, data management constraints are felt throughout the region. The size of the region and the voluminous amounts of information already available require extensive computer management of data, which is hard to achieve. More attention to data administration is needed as agencies and landowners attempt to utilize existing data for planning and management direction. Long-term maintenance of data bases is a real problem, largely due to a lack of dedicated funds. Lack of consistency among data standards and data sets continues to impede the ability to create common data bases and to share existing data.

Similar issues have been raised in the Pacific Northwest, emphasized during the recent exercise to craft the President's Forest Plan for the region. Participants in the Pacific Northwest survey team study recognized that inadequate data exchange between federal agencies and managers, regulators and land managers, and federal and nonfederal entities fosters distrust, inhibiting an effective, creative evaluation of problems and development of possible solutions. Emphasis was therefore placed on a greater need for standardization, on establishment of common technical data sets, and on collection of data on broader spatial and temporal scales. Lack of consistency and compatibility in data collection and storage is a major problem. Differences in data, analysis methods, and historical records make comparison difficult.

Alaska maintains Public Information Centers distributed throughout the state to provide planners and developers with all necessary information on permits. In both Prince William Sound and the Anacostia River watershed, survey teams found a

widespread desire for "one-stop shopping" for regulatory information—a single set of data on federal permits and regulatory processes.

Training and Education

For an ecosystem vision to be shared and for principles of the ecosystem approach to be effectively implemented, employees must not only understand ecological systems and the relationships among ecological, social, and economic systems, they must also acquire the interpersonal skills to effectively participate in two-way communication. An ecosystem approach to natural resource management differs from traditional approaches, requiring training in dealing with change itself. Many federal agencies are aware of increased training needs in ecosystem approaches and are taking action. However, because the ecosystem approach requires us to think and act differently, there are barriers to getting the job done effectively. Barriers are of two types: lack of training in general, and the unique challenges presented by training specifically in the ecosystem approach.

A need for general training in the ecosystem approach has been identified in many areas. For example, survey team studies found a need for more ecosystem-related training in the Anacostia River watershed and Great Lakes basin, and federal employees who lead training efforts in their respective agencies have also called for more training. Lack of training could easily be remedied through training programs, but the federal workforce is rapidly shrinking, and as more and more employees leave the federal workforce, remaining employees must assume a growing workload. Short-staffed managers are reluctant to devote additional employee time to increased training, and shortages in fiscal resources make it difficult to afford increased training. Despite such constraints, some agencies are maintaining their emphasis on training and continued education. For example, in a September 1994 speech to the Society of American Foresters, the Forest Service Chief announced, "I have given out the word that we can't cut back on training."

As a discipline, understanding ecological theory presents additional, unique challenges in the realm of training. Because the ecosystem approach cuts across agency functions and geographic areas, federal agencies must conduct training in a coordinated fashion and incorporate the concept of

crosstraining. For example, Fish and Wildlife Service employees need training in forestry, and Forest Service employees need training in wildlife management. Given the complexities of ecosystem functions and the integration of ecological, social, and economic factors in ecosystems, no single discipline can provide all necessary expertise. Interdisciplinary teams must be organized and trained to implement the ecosystem approach. Coordinated training efforts and joint training will require substantially more planning within and among federal agencies in order to minimize redundancies and to ensure development of effective training programs.

Some of this coordination is already underway. One important ongoing effort to promote interagency cooperation in training is conducted by an ad hoc group, the Interagency Ecosystem Management Training Group, started in 1994 with representatives from 14 agencies. This group is trying to coordinate efforts in ecosystem approach training—without formal blessing from agency heads.

Each of the federal agencies in the ad hoc group conducts some type of training in the ecosystem approach. The Bureau of Land Management has a large program at the National Training Center in Arizona. Each year, more than 300 courses on a variety of topics (including the ecosystem approach) are offered to federal employees from many different agencies and to nonfederal employees (including representatives from state agencies and the private sector). The Natural Resources Conservation Service is developing a program to teach its employees how to integrate ecosystem concepts into ongoing programs. This training program will use satellite technology to reach as many employees as possible in a cost-effective manner. Recently, the Forest Service Chief announced that all employees will receive some form of training in the concepts of the ecosystem approach, and the agency has a task force working to implement this training across the entire agency. A critical challenge in developing this program will be deciding what level of training in the ecosystem approach each employee should receive.

The holistic educational effort needed includes training in the social sciences: the human dimension of the ecosystem approach is too often overlooked. More training is needed in conflict resolution and in problem solving in difficult situations.

The Forest Service and other agencies are focusing on training top leadership in techniques for collaborative planning. These techniques provide tools for crafting solutions to difficult problems through thorough, facilitated dialogue among discussion participants. Under this approach, consensus is only a partial solution: the ultimate goal is to reach a higher level of problem resolution through collaboration. An example of collaborative planning in action is the Colorado Roundtable, composed of representatives of grazing and environmental groups trying to solve range problems in the Rocky Mountains.

Traditionally, those trained in the biological and physical sciences have lacked experience in relating to the public and in making technical information easily understood. One reason is that "experts" often feel privileged as authoritative repositories of knowledge to which the public has nothing of value to contribute. There is clear evidence that many people, especially those who live and work in or near rural areas, have a deep (albeit often nontechnical) understanding of ecosystems.

Listening more intently is important in our efforts to involve the public in the ecosystem approach (see chapter on Public Participation in this volume). We must recognize that our technical elitism may impair our listening abilities, constraining our ability to facilitate meaningful public participation. For example, the Forest Service dampens enthusiasm for effective public participation when it presents a management plan for a national forest to the public as a fait accompli. Often, the preferred alternative is presented, giving the correct impression that the agency already knows what it wants to do and is requesting public input only pro forma.

Training natural resource managers in principles of the ecosystem approach is really only part of the solution: public education must also be provided. A knowledgeable public can be of enormous assistance in getting things done in the field: resistance to federal land management techniques is reduced, and the quality of public involvement dramatically rises. However, federal managers need training in public education techniques. For example, they must learn to present the ecosystem approach not as a goal or end in itself, but rather as a means to sustain natural ecosystems and the human communities that depend on them. We

have not focused enough on why we take an ecosystem approach; the concept of the ecosystem approach is more understandable when presented with the goal in mind of improving the quality of human life.

The need for basic understanding of ecosystem approaches is not unique to federal personnel: education and training of federal workers reach only some of the players in the partnerships necessary for successful implementation of the ecosystem approach. Training should also be made available to nonfederal parties at local, state, and regional levels, whose decisions concerning use and conservation of public and private resources can significantly affect the outcome of even the best planned management programs. Basic primers in the ecosystem approach should be developed for public officials, planners, and the general public.

OBSERVATIONS AND RECOMMENDATIONS

Federal agency ability to facilitate the ecosystem approach would be greatly enhanced if agency structures were modified to address key institutional issues: shared vision and leadership; adaptive management; organizational structure; performance measures and accountability; information accessibility, usability, and communication; and training and education in the ecosystem approach. The following observations are based on considerable discussion, and on careful review of survey team studies (see Interagency Ecosystem Management Work Group 1995, volume 3). Recommendations are intended to provide a basis for discussion of institutional improvements to facilitate the ecosystem approach.

Shared Vision and Leadership

Effective vision and leadership depend on:

- **Universal participation.** Agencies should engage all managers, line officers, and staff in consensus building, including development of mission and guiding principles. Corporate vision and strategic thinking cannot be imposed from the top if they are to be fully accepted; they must be jointly "owned" by all managers in an organization. Even in agencies with a strong hierarchical

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structure, agencywide vision can be fostered—but it takes time and work.

- **Reliance on local initiative.** Overarching goals and objectives should be established at the national level, but local managers should collaborate with local citizenry to establish common local and ecoregional goals. Implementation based solely on a shared vision from a national perspective will fail; successful implementation of ecosystem management principles depends on a shared vision at the local level. Federal agencies should encourage locally driven initiatives, playing the role of facilitator.
- **Flexibility in pursuing missions.** In pursuing their missions, agencies should strive for flexibility in addressing ecosystem-based issues and management objectives, and for more collaboration with other agencies and nongovernmental organizations.

Adaptive Management

An adaptive approach to natural resource management should include:

- **An experimental design for implementation.** Adaptive management requires a rigorous scientific approach to management in order to reduce uncertainty and to benefit from unexpected events. This process will be effective only if monitoring and evaluation procedures are designed as integral parts of the process from the outset. Part of the actual management plan should include experiments designed to produce useful information on the outcome of plans and practices.
- **Well-defined goals and objectives.** Goals and objectives must be integrated into both the planning process and the experimental design of monitoring programs.
- **Identification of uncertainties.** Management decisions will be made under circumstances that contain varying degrees of uncertainty. Identification of areas of uncertainty facilitates consideration of a range of possible outcomes under different management scenarios. This is important to consider when designing monitoring programs.
- **An adequate monitoring and evaluation program.** Monitoring is the critical link between management actions and outcomes. Monitoring programs establish how management practices are operating and developing over time, at different spatial scales, and under different conditions. They provide both positive and negative feedback on the ecological, social, and economic effects of management decisions—the information needed to measure progress toward goals. One of the most important aspects of adequate monitoring is longevity: far too often, monitoring is much too brief to provide the kind of information needed to adequately evaluate the results of management actions. Monitoring programs must be designed with appropriate temporal and spatial scales in mind. For ecosystems, this usually means long-term programs designed to establish baselines and to measure the effects of management actions. A critical link must also be established between the gathering of information through monitoring and its use in evaluating and potentially changing management practices.
- **Using an adaptable structure.** The adaptive management concept requires an organizational structure that is flexible and capable of change in response to changing conditions and to lessons learned from past experience. A key element in this flexible structure is a management system that operates strategically, emphasizing functional skills and eliminating inflexible organizational barriers.
- **Supporting learning at all levels.** The core tenet of adaptive management is to learn from past experience. People involved at all levels of an adaptive management process must be encouraged and rewarded for learning about the ecological, social, and economic aspects of their work and decision making, and for adapting to new information and incorporating lessons learned.
- **Accept “risk.”** Decision makers and policymakers across government tend to be averse to risk taking—they desire certainty

in decision-making outcomes. Adaptive management can only be achieved when a level of uncertainty in decision making is accepted.

Organizational Structure

The ecosystem approach can be improved through:

- **Regional interagency bodies.** Regional interagency groups, either formal or informal, could be established to develop, monitor, and oversee implementation of plans for the ecosystem approach. This will facilitate interaction among federal, state, and local agencies and organizations, and among managers, scientists, and the user public. The importance of having a broadly inclusive umbrella group to resolve regional conflicts is reiterated in every survey team study, despite differences in form, history, function, and rules. Exchange of employees among agencies, regions, and specialty areas can facilitate the process.
- **Integration of urban and natural resource management.** Particular efforts must be made to address interrelationships between institutions that focus on natural environments (such as the Natural Resources Conservation Service) and those that focus on urban environments (such as the Department of Housing and Urban Development). It is crucial that information be exchanged between these types of institutions and that they participate jointly in ecosystem and suburban or urban planning. Local, state, and regional data bases and plans should be consulted early in ecosystem planning to determine potential barriers and opportunities to be discussed. This would permit possible consequences of a range of actions to be outlined, including outcomes if ecosystem approaches are not taken. Sharing and review of data and plans is essential.
- **Ecosystem considerations in all agency activities.** Each department and agency should incorporate ecosystem considerations into activities related to upcoming reauthorization of existing bills.

- **Structural review within agencies.** Agencies should reevaluate their organizational structure (especially the character of subunits) to determine whether a different structure would facilitate the ecosystem approach or other systematic interdisciplinary needs. Agencies with separate units for science, National Environmental Policy Act compliance, and planning and management of lands and facilities may be able to coordinate often disparate actions in a systematic, synergistic manner to facilitate an ecosystem approach.
- **Program-level environmental impact statements.** Agencies should utilize program-level environmental impact statements to analyze and plan in a systems-oriented, broad-scale manner that takes into account all related ecological, social, and economic activities likely to occur within a region. Broad programmatic environmental impact statements can then be applied to separate agency actions within an ecosystem. In the long run, application of this tool can be cost-effective by eliminating the redundancy of many smaller environmental impact statements for each action. Its use in evaluating systemwide impacts of planned activities can help to avoid disastrous conflicts between actions planned in isolation.

Performance Measures and Accountability

The ecosystem approach can be facilitated through:

- **Common ecosystem indicators.** A common set of ecosystem condition indicators should be developed and established. There should be an interagency effort to devise two sets of indicators: one for regional or national evaluation, and another for site-specific planning.
- **A common set of performance measures.** Agency budgets and personnel levels should be tied to measurable performance through a common set of ecosystem performance accountability measures.

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- ***Job performance ratings based on the ecosystem approach.*** The employee performance rating system should be used to encourage an ecosystem approach.
- ***Awards for implementing the ecosystem approach.*** The ecosystem approach and interagency collaboration should be encouraged through agency and individual awards. The White House or Office of Management and Budget could bestow multiagency awards on agencies that collaborate and share resources in productive and innovative ways to enhance ecosystem health. Agencies should reward employee teams that contribute significantly to ecosystem health through interdisciplinary efforts.
- ***Grants for building partnerships.*** Grants programs for partnership building should be established or expanded. Within each agency's program responsibilities, matching grants could be provided to the nonfederal sector based on the diversity, size, complexity, and need of the partnership. Cost-sharing by the partner should be a criterion of partnership.
- ***Incentives.*** Incentives for the private sector, such as the Forest Service's Stewardship Incentive Program, could be developed.
- ***Reform of the permitting process.*** The permitting process should be modified to encourage an ecosystems approach to management. Permits should be granted with impact criteria that take a full range of ecosystem functions into account.
- ***Revision of regulations.*** Regulations that are sensitive to an ecosystem approach to management should be written. Regulations should encourage use of the principles of the ecosystem approach, evaluating impacts from an ecosystem perspective. Both regulations and the activities being regulated should be evaluated in terms of ecosystem principles.

Information Accessibility, Usability, and Communication

Information on ecosystems can be made more accessible and usable by developing electronic networks to enhance communications, information

exchange, collaboration, and empowerment among agencies involved in ecosystem-related activities. Networks should build upon existing efforts rather than compete with them. The Council on Environmental Quality should facilitate the development of an efficient ecosystem data access, including full coordination with the Federal Geographic Data Committee (a geospatial data clearinghouse), the National Biological Information Infrastructure, and other data networks, such as the Committee on Environment and Natural Resources' Observations and Data Management Task Force and the Global Learning and Observations to Benefit the Environment initiative.

Training and Education

Measures to enhance training and education in the ecosystem approach should include:

- ***Minimum competency expectations.*** Agencies should set minimum competencies for all employees in understanding and utilizing the principles of the ecosystem approach (which should vary, depending upon position in the organization).
- ***Training programs.*** Some minimal level of training or continuing education should be expected for all employees, even under reduced budgets. Establishing a 1 percent set-aside for training in each agency would be one way of providing for training programs.
- ***Joint training.*** Agencies should coordinate and combine or integrate their training exercises. Joint training should be adopted as the main approach federal agencies use in ecosystem management training. Nonfederal personnel should be encouraged to attend federal training sessions and/or to use similar material to develop their own training opportunities.
- ***Interagency personnel exchanges.*** Federal workforce job capabilities should be potentiated by providing opportunities for job swapping. Because interagency teams are a growing trend in natural resource management, the federal government should make it easier for employees from one agency to swap jobs with like-minded individuals from other agencies for varying periods of time.

Chapter 4: PUBLIC PARTICIPATION IN THE ECOSYSTEM APPROACH

The federal government depends a great deal on public input in making decisions, especially under the ecosystem approach. The principles of this approach, outlined in volume 1 of this series (Interagency Ecosystem Management Task Force 1995), address the need for give and take, with responsibilities for both the federal government and the public. Under the ecosystem approach, a shared vision of the desired ecosystem is developed, taking into account existing social and economic conditions, and identifying ways in which all stakeholders can contribute to—and benefit from—achieving ecosystem goals. Where possible, federal agencies work collaboratively with state, local, and tribal governments to address mutual concerns, and with private landowners to accomplish shared goals while respecting property rights.

The public has a right to expect the government to establish a mechanism for reviewing issues or potential actions and for presenting those with far-reaching effects to the public for discussion. At the same time, the public must be aware of and able to use that mechanism to raise issues that it considers important. The federal government must ensure that issues, proposals, or projects are presented systematically, fairly, and clearly to sectors of the public that might be interested or affected. Issues that are most far-reaching and have the greatest impact should receive the most attention.

Public input can be varied and conflicting. For example, those who live in local communities directly affected by management decisions on public lands may have a different perspective than taxpayers at the national level. Federal agencies must weigh public input from local, regional, and national stakeholders—including those in commerce and industry—and balance them carefully against each other in making management decisions.

All survey team studies in volume 3 of this series (Interagency Ecosystem Management Task Force 1995) stress the importance of public education, public access to information, and public participation in decision making. Equally important is the need for better communication and coordination

among federal agencies in attempting to include the public in the ecosystem approach. Involving the public early and maintaining public involvement throughout the decision-making and implementation processes are fundamental to a successful ecosystem approach. To be effective, agencies must consider public perceptions and understand public values concerning ecosystems, and they must provide education about the relationship between public health and the health of the ecosystems in which we all live.

Public participation in the ecosystem approach can take several forms. First, members of the public can help agencies with the immense task of grasping the human dimensions of problems in ecosystems, and of gathering biological and physical information across various geographic scales. The public helps identify problems, define goals and opportunities, and design possible scenarios for the future. Their input provides the credibility and acceptability of projects and programs. The broader the participation and the more diverse the information included, the more likely it is that a project will address problems fairly and successfully.

Second, public participation can build long-term relationships among tribes, agencies, and citizens. These relationships, developed for a wide variety of reasons, are essential if goals under the ecosystem approach are to be realized.

Third, public participation keeps expectations realistic. Public participation provides opportunities for give and take on information, so that we can move forward with a shared understanding. The more public participation there is in decision making, the less possibility of surprises.

The first part of this chapter offers examples of what agencies and organizations are doing to include the public in the ecosystem approach, drawn in part from interagency survey team studies in seven key ecosystems nationwide. The second part of the chapter delineates barriers to public involvement in the ecosystem approach and opportunities for sustaining and potentiating public participation in ecosystem approaches. Finally,

recommendations are offered for overcoming barriers and taking advantage of opportunities to ensure public input into the ecosystem approach so that it enjoys full public support.

MOVING TOWARD AN ECOSYSTEM APPROACH

In 1969, the National Environmental Policy Act (NEPA) formalized the requirement that federal agencies submit a wide array of proposed federal actions to the public for consideration. Although NEPA has greatly helped to institutionalize public participation in federal programs, stakeholders expect even more participation in the decision-making process. NEPA requires public involvement prior to an action; today, however, the public expects to be consulted long before a proposed action has been developed. To successfully meet this demand, federal agencies must decide how best to provide a variety of participation opportunities, given time, funding, and other constraints.

For years, federal agencies have held public meetings and circulated draft documents to gather comments on proposed plans. Now there is more emphasis on involving the public at the beginning of a process—the point when problems are defined, data is gathered, and relationships with stakeholders are established. This new emphasis is based on recognition that knowledge grows out of shared experience, and that nontechnical information that reflects people's desires, experiences, and opinions is vital to any successful program.

Typically, there are three types of efforts to involve the public in federal programs: facilitating access to information; providing educational opportunities; and soliciting public input through dialogue.

Public Access to Information

Providing access to information includes making planning and other documents available, conducting public comment periods, and establishing personal contact with the public. Federal agencies have improved substantially in their efforts to make technical documents more understandable, to provide materials in other languages, and to ensure that planners and technical experts are able to communicate with the public. For example:

- The U.S. Army Corps of Engineers (Corps) and other agencies are using computer models in their work with the public on particular planning problems. An object-oriented computer model known as STELLA has been used to illustrate the effects of alternative river release schedules.
- A toll-free hotline was established for the Anacostia River watershed restoration initiative so the public could get information and register concerns.
- A U.S. Department of Agriculture Forest Service ranger district in Idaho has videotaped informal presentations by planners on possible futures for a roadless area. The videos are available free of charge at local video rental stores.

Public Education

Federal agencies provide the public with opportunities to learn about ecosystems and federal activities to implement the ecosystem approach. Educational programs place environmental issues in their broader political, social, economic, and biological contexts, promoting public sensitivity to environmental problems and federal efforts to address them. They are designed to elicit informed public input into federal activities under the ecosystem approach, and to generate interest and involvement on the part of previously excluded groups, such as low-income and minority communities (through paid job and volunteer programs). Besides supporting volunteer programs, educational efforts include developing curriculum materials in partnership with school districts or state agencies, and distributing interpretive materials on restoration efforts (such as those in the Chesapeake Bay). Current educational opportunities include:

- In the Southern Appalachians, the Southern Appalachian Man and the Biosphere Reserve has sponsored videotapes and publications designed to educate the public. A recent Emmy Award-winning video under the title "Front Runner" featured the reintroduction of the red wolf in Great Smoky Mountains National Park. The video came with a teacher's guide and poster.

- Outside of St. Louis, Missouri, at the Corps' Riverlands Environmental Demonstration Area, volunteers have built nature trails, constructed observation platforms, and planted trees. The area features an onsite "living classroom" and provides math and science curriculum materials designed to increase students' environmental knowledge.
- In Prince William Sound, Alaska, the National Oceanic and Atmospheric Administration is conducting a mussel research project that involves local communities in collecting mussel samples.

Public Dialogue

Although federal agencies now do a better job than ever before of engaging the public in dialogue, citizen input is typically limited to contributions at public meetings and to written comments on proposed federal actions. Federal agencies continue to wrestle with the problem of getting public input early in the process, and of ensuring its careful consideration by decision makers. However, federal and state agencies are making strides in both regards. For example, citizens participated early in the process of defining problems and making decisions related to a Corps study in South Florida. Similarly, citizens were able to define their own development goals before the state of Alaska's Department of Community and Regional Affairs.

Examples of efforts by federal agencies to facilitate citizen input include the following:

- The Forest Service's Northern Region developed a comment analysis data base and software program to summarize the 40,000 letters received during development of the gray wolf reintroduction program in Idaho.
- The Bureau of Land Management can download electronic mail responses from the public directly into a content analysis software program.
- The Forest Service's Southwestern Region, its Rocky Mountain Forest and Range Experiment Station, and Colorado State University are cooperating with various Mexican agencies and private groups in developing an ecosystem approach for the Ejido El Largo. The *ejido* is communally held land (500,000 acres, primarily forest), with more than 1,500 "shareholders." Following a week of meetings, field trips, and general orientation, project participants worked with a local social worker to individually interview 10 percent of the shareholders in order to identify problems, goals, and objectives for the *ejido's* new 10-year plan.
- Region 6 of the Environmental Protection Agency (EPA) recently sponsored a marsh management workshop in New Orleans. The informative workshop was well attended by landowners, nongovernmental organizations (NGOs), university researchers, and federal and state land managers, helping to bridge differences between factions in the marsh management debate.
- The 1991 Intermodal Surface Transportation Efficiency Act mandated early, continuous public participation in transportation planning. Contractors designed a decision-making tool for the Oregon Department of Transportation that helps the public to set values, and that links value measurements to transportation, costs, environmental factors, and quality of life.
- In New Hampshire, the Forest Service's Northeastern Area and Northeastern Forest Experiment Station are cooperating with White Mountain National Forest to implement a statewide Forest Resources Plan. As part of the planning process, about 50 people from the private, public, and nonprofit sectors were asked to participate in Assessment Groups to evaluate economic forest uses, the ecological condition of New Hampshire's forests, and forest-related human and social values. Active participation by large industrial and small nonindustrial landowners on Assessment Groups and on a Steering Committee for the Plan ensures respect for property rights. A central part of the Plan will likely be to establish mechanisms to provide landowners with access to scientific information and guidelines for forest management applications.

ACHIEVING AN ECOSYSTEM APPROACH

The importance of early and continuous public participation was a predominant theme in discussions with federal, state, local, tribal, and nongovernment stakeholders in all seven ecosystems studied by survey teams. Stakeholders pointed to the need for better coordination and communication among federal agencies involved in the ecosystem approach as a prerequisite to good two-way communication with the public. Several principles or common themes emerged from survey team interviews and other projects and studies: the importance of public access to information and public input into decision making; the need to empower a public not always privy to expert technical information; the importance of incorporating the human dimensions of environmental problems into the ecosystem approach; the need to be fair with the public; the need for good communication; the necessity of staying in close touch with the public; and the importance of early and continuous public involvement.

Information Access and Decision-Making Input

Public involvement can be greatly stimulated by opening the process to the greatest number of participants possible representing the widest range of interests feasible. However, opening the process depends on overcoming real and perceived barriers. In locations such as Coastal Louisiana, for example, where legislation and grassroots efforts produced large federal programs, the public expected to have a larger hand in the process, and many federal efforts have been perceived and criticized as management from the top down rather than from the bottom up. According to interviewees at some of the sites, no attempt was made to develop an overall vision for the area with the public before federal agencies started to plan projects.

Federal efforts to implement the ecosystem approach can also conflict unnecessarily with state and local goals, in spite of a desire among many federal employees to work more closely with states and local governments. More flexibility and less rigidity are needed in planning processes if agencies are truly to collaborate with states and communities.

Interviewees at some sites voiced frustration with the cumbersome process of dealing with federal agencies. For example, several interviewees complained that one must go to too many places for project approval, and that a single repository of information or permitting authority that provides one-stop service is needed.

Many interviewees complained that information on a project is difficult to get after the planning phase is over. Accessibility can be improved in several ways: by opening most meetings to the public; by developing a list of key contacts to be notified of meetings; by gathering information from the public; and by disseminating timely information through personal contact, mailing lists, the news media, the Internet, and the Federal Register. In many instances, third-party sponsorship of public meetings by oversight groups or not-for-profit foundations (such as the Chesapeake Bay Foundation) has succeeded in drawing more public participation.

The National Environmental Policy Act provides very important ways of getting the public involved and of disseminating public information. The Act requires federal agencies to assess and disclose the full consequences of their actions (including biological and human health impacts beyond their jurisdictions), thereby encouraging all interested and affected stakeholders to become involved. Regulations require that federal agencies "to the fullest extent possible . . . [e]ncourage and facilitate public involvement in decisions which affect the quality of the human environment." Agencies must provide opportunities for public comment at the scoping stages of a project, and at preparation stages for draft and final environmental impact statements. Environmental impact statements must contain a discussion of "inconsistencies of [federal agencies'] proposed actions with State or local plans and laws." When fully implemented, the National Environmental Policy Act can be an important tool for supporting the collaboration and consensus-building essential to the ecosystem approach. This support could include bringing stakeholders together to develop a shared vision for an ecosystem, recognizing problems as shared problems, looking past stereotypes and false impressions that can divide stakeholders, engaging in joint data collection and analysis, and arriving at creative and innovative solutions to

ecosystemwide problems. Additionally, the Act could be used proactively to improve ecological and socioeconomic impact assessment, interagency coordination, and nonfederal involvement as a framework for planning under the ecosystem approach.

Leveling the Playing Field

The enormity of ecosystem issues and the technical knowledge required to fully understand them can be overwhelming. Lack of adequate information, competing demands on people's time, and the failure of federal agencies to explain the relevancy of issues may prevent the parties involved in an ecosystem from understanding each other's needs and perspectives and arriving at agreed-upon solutions to basic environmental problems. Even the term ecosystem approach can mean different things to different people. The lack of a common definition that most people find compelling increases confusion and breeds conflict. Ensuring that people are provided with the same definitions and information can help to correct power imbalances among groups and to establish a basis for cooperation in realizing goals under the ecosystem approach.

Several interviewees mentioned the inconvenience of meeting locations. The need to travel great distances discourages attendance at public meetings to discuss environmental problems and plans, undermining meaningful public involvement. For example, attendance at regional meetings is a problem, according to some, who maintained that planners must go to local communities in order to reach the public. When planning meetings, agencies must take into account the barriers of distance and time, and the reality that many people cannot afford to participate. Such methods as teleconferencing, establishing distribution networks, and scheduling meetings at convenient times and various places would greatly improve the situation. Moreover, the nature and timeliness of meeting-related information pose a problem for some. Interviewees complained about the length and complexity of ecosystem-related documents, often received just before an important meeting or comment period deadline, with little time for review.

Many agencies have done a good job of identifying and contacting stakeholders, but need to work more at building long-term relationships.

Relationship building requires huge amounts of time, and it may take years for some agencies to gain public trust. In many areas, more proactive and substantial outreach efforts are needed to address the complexity of the issues, the scope and importance of possible outcomes, and the high level of interest shown by unaffiliated sectors of the public.

The Federal Advisory Committee Act was repeatedly criticized for its chilling effect on public participation in federal decision making (see chapter on Legal Authorities). The Act places restrictions on nonfederal committees that advise federal agencies. Some committees that were formed without a charter have had to be dissolved, while others have struggled on, with little or no funding. Some groups have concluded that advising federal agencies is futile due to interminable delays in obtaining a charter to provide input that will not be used. Some federal interviewees are equally frustrated, fearing that many activities designed to obtain public input (such as charrettes, Delphi techniques, and regular meetings with stakeholders) run a risk of violating the Act.

The ultimate source of the problem remains uncertain: it may lie in the excessive breadth of the law itself, in its conflicts with other laws, or in its misinterpretation and misapplication by federal agencies. Resolution of issues pertaining to the Federal Advisory Committee Act can begin with a better understanding of the law. Improved implementation of the Act would help to reconcile the need for a more collaborative process of federal planning with the assurance of an open process of federal decision making.

Human Dimensions of Environmental Issues

In the interest of scientific credibility, we often limit ourselves to a scientific or technical approach to ecosystem management. But the public is usually concerned with the human dimensions of ecosystems, which must be carefully considered by federal agencies if their projects and programs are to enjoy public support. Because the ecosystem approach is a human construct, it must incorporate socially defined goals and management objectives.

Federal agencies have often been criticized for ignoring the human dimensions information that

the public considers vital. In one survey team study, interviewees observed that agencies seemed nervous about drawing on public opinion, averse to the risk of incorporating human dimensions information into activities traditionally based on "the best science available." According to some interviewees, agencies appeared to harbor a hidden agenda that made them suspicious of private industry and unresponsive to academics and private industry representatives with innovative ideas to offer. Moreover, agencies seemed reluctant to communicate how project plans are designed and decisions made. Public education has been most effective when federal agencies have formed teams with state agencies, schools, NGOs, and others to produce videos, hold workshops (such as the recent marsh management workshop in New Orleans, sponsored by EPA and others), and enlist volunteers in monitoring, data collection, and restoration work.

Fairness

Federal outreach efforts were criticized by some local government and NGO interviewees as inadequate and unfair. Others, who appeared to be key stakeholders who know the right people and how to get information, expressed greater satisfaction with the public participation process. Tribal government representatives, such as those in the Pacific Northwest, voiced frustration with the Federal Advisory Committee Act and with the tendency of federal agencies to underemphasize or ignore government-to-government relationships in decision making, even though Executive Order 82198 accords government-to-government recognition to tribal governments. In the Anacostia River watershed, interviewees complained that ecosystem planners are unfamiliar with the culture and particular needs of low-income communities in the area.

To encourage fairness, agencies should involve other agencies, local governments, NGOs, and the public early in the process of developing plans and milestones for public participation, thereby ensuring that planned efforts are in line with stakeholder expectations. At the same time, it should be made clear that historical relationships with interest groups are important parts of the ecosystem approach and should be integrated into it.

Some federal interviewees voiced frustration with fluctuations in public responses to their outreach efforts. Substantial efforts to involve the public at

early stages in certain projects met with apparent disinterest, but at later stages, agencies were suddenly hammered by negative public opinion and even by litigation from interest groups.

Communication

Communication problems have plagued many interagency ecosystem approach efforts from the beginning. In some cases, there seemed to be no overall plan for communication with the public. Some interviewees noted that public meetings they attended were almost entirely informational (featuring slide shows, presentations by planners, and similar items), with little time for exchanging views. Citizens often believe that their comments are ignored and that public input functions only to validate a predetermined decision. Public meetings normally do not foster broad-based exchange, because they tend to focus on parochial concerns defined by geography or local interest.

Efforts can be made to encourage those with strong views and conflicting opinions to meet with each other by traveling to public meetings in other areas or with other interest groups. In South Florida, for example, those representing agricultural and environmental interests traveled to other areas to express their opinions. A response technique used at the meetings gathered information from 60 to 70 percent of those attending, rather than merely the 10 to 15 percent of those who usually speak. Time was set aside for diverse groups to share their views informally, rather than only during the oral comment period.

Interagency efforts should include a communication strategy and dedicated staff to ensure its implementation. Communication strategies should be based on systematic, structured research, and constantly revised as the effectiveness of a program is monitored. Communication products that have been reviewed by focus groups representing the intended recipients will better address the needs of both communicating agency and recipient group. Communication strategies should outline techniques and approaches for bringing the public into the planning process; they should be developed with public participation and widely publicized. Agency personnel responsible for outreach programs should be well trained in public interaction, and especially in proactive approaches.

Interagency communication is becoming the established way of doing business in areas where there are interagency efforts to take the ecosystem approach. Some interviewees said that interagency programs (such as those in Coastal Louisiana) have gotten agencies together for the first time, and that other programs (such as the Coastal America Partnership) have provided the opportunity for regular meetings in which representatives from various groups can exchange information on their activities. Although some problems remain to be resolved, agencies have made real headway in working together.

Accountability and Keeping in Touch

The public is more likely to be engaged if it understands how to get involved. Federal agencies could provide better outreach and encourage more public participation through early notification and clear explanation of the steps involved in specific efforts guided by the ecosystem approach.

After initial outreach, agencies often seem to vanish without ever telling the public how its input was used in decision making, or even what the decision was. It is vital that the public get feedback on how its comments and suggestions affect agency decisions and actions. The outcome of efforts, including research results, should also be communicated to the public. In South Florida, information gathered during the first round of public meetings was analyzed and addressed during a second round of meetings to show how public concerns had been incorporated into the objectives and constraints of the project.

Early and Continuous Involvement

Private property issues were particularly controversial at many sites visited by survey teams, and adherence to tribal treaties was also a vital concern. Many interviewees complained that federal agencies failed to consult with landowners early in the decision-making process and to obtain specific information from them, such as when and where they needed to have access to the decision-making process. According to many interviewees, agencies tended to take already prepared plans to landowners for rubberstamping. This problem can be remedied by soliciting public input early enough in the process to assist in defining the problem and in designing potential solutions.

Some interviewees complained about decision making delays and the failure of federal agencies to respond quickly to urgent public issues. However, building relationships with stakeholders takes considerable time, and the integrated processes needed for effective public participation often encompass several geographical and temporal scales. Moreover, agencies are often constrained in working with the public by budgets and time-frames imposed by statute or regulation.

Scientists and researchers must be steadily engaged from the outset in federal efforts under the ecosystem approach. The anti-research bias of some federal and state managers was pointed to in survey team interviews as a serious problem. Already treated with suspicion by some government stakeholders, scientists were sometimes brought into the process too late, when frustration was already high. To avoid negative perceptions and to convey information effectively, public affairs specialists should work closely with scientists to help translate technical information into understandable language.

RECOMMENDATIONS

Survey team studies revealed active public participation in federal programs in all seven ecosystems, although there was often room for improvement. Federal agencies should strive to improve coordination of public participation, enhance federal communication programs, organize public participation programs within agencies, and implement effective mechanisms to improve public participation. The following recommendations are not meant to provide a complete list of steps to take to ensure public participation, but rather to provide a basis for increased federal commitment to involving the public in the ecosystem approach.

- ***Coordinate public participation efforts.***

Federal agencies should increase coordination of public participation, especially in areas where interagency efforts are underway. Due to limited budgets and resources, agencies may have no other alternative to interagency coordination if they truly wish to facilitate public participation. Because each agency has its own constituency, an interagency effort can bring together the entire constituency within an ecosystem, broadening support for the ecosystem

approach. Interagency coordination can eliminate redundant efforts and potentiate the work of one agency through the complementary work of another. In South Florida, for example, a technical input group from the Corps, National Park Service, and state of Florida provided ideas and recommendations for a study team to use in designing the public involvement process. The group provided ideas, feedback, and information on people, places, and other matters related to the South Florida ecosystem.

One specific suggestion that emerged in survey team studies is to use an interagency team to work with individual agencies to establish public participation plans where they do not yet exist. Each project or area-wide public participation plan would form a tier in a larger plan, complementing other public participation efforts as part of an overall plan and strategy. Another specific suggestion is to facilitate interagency coordination by co-locating federal offices in a single building or complex, thereby improving opportunities for communication and loosening restrictions on sharing personnel.

- ***Facilitate public communication and participation.*** Federal programs should be designed to facilitate communication with the public and to increase public participation. Several steps can be taken to enhance federal programs to increase public participation. Because effective public participation requires time to develop and nurture, agencies must commit resources over the longer term. Public participation efforts are more efficient if the basis of public awareness and trust developed for one project can serve other projects in the same region.

A common constraint to public participation is lack of specialized staff able to devote full time to the duty of involving the public. Federal agencies should ensure that sufficient staff are dedicated to this task, and that a better mix of technical and science specialists is available to advise federal agencies. These specialists should include social scientists and others who see the big picture.

Agency personnel responsible for outreach programs should be adequately trained in public interaction, especially in proactive approaches. Agency personnel who interact with the public should be dedicated, well trained in public participation skills, and well versed in the provisions and application of the Federal Advisory Committee Act. Training in public participation might be offered in a particular region and attended by federal and state employees, NGO members, and other stakeholders.

Because many ecosystems are of nationwide and even international concern, there is a need to educate and to facilitate dialogue among stakeholders at the national level, including members of Congress, representatives of industry, and those from conservation groups, private property rights groups, and other organizations.

A great deal of concern was expressed in survey team studies about how Federal Advisory Committee Act requirements affect citizen advisory groups, which are frequently formed under legislative or judicial directive. Although these committees can be effective in representing the views of selected interests, they do not necessarily represent the views of the public. Where a citizen advisory group is used, other means of informing and educating the public and of soliciting public input should also be expected.

- ***Use the National Environmental Policy Act (NEPA) to fullest advantage.*** Federal agencies should use the NEPA process to the fullest extent possible to increase collaborative public involvement. The NEPA and regulations issued by the White House's Council on Environmental Quality (CEQ) (40 CFR 1500–1509) provide useful guidance to federal agencies for consistently involving the public and for prescribing procedures to guide public participation. Federal agencies and the public have been using the NEPA process for more than 25 years to facilitate information exchange and dialogue on federal programs and projects.

Federal agencies should be encouraged to use the NEPA process for program and project planning under the ecosystem approach. Other recommendations made here can be followed most effectively if integrated into the NEPA process. Agencies can thereby take advantage of existing planning and decision-making processes to enhance and increase public participation.

The CEQ should examine NEPA in order to develop recommendations and guidance for more uniformly and systematically facilitating public involvement. Because public participation in environmental assessments is not clearly required under its current regulations, the CEQ should review current guidelines, particularly with regard to environmental assessments performed at the regional ecosystem scale, but also with regard to site-specific environmental assessments, and consider prescribing procedures to enhance public participation and make it more collaborative. The CEQ should solicit public input and feedback from federal agencies in the course of its review. In addition, the role of NEPA in facilitating public participation should be publicized in order to encourage wider public involvement, especially by groups or individuals who do not yet know that this opportunity exists.

- ***Systematically organize agency programs.*** Federal agencies should take steps to systematically organize their public participation programs. They should assess the present level of their public education activities, identify priority needs, and determine which needs can best be met. Procedures should be established for monitoring the overall process of public participation, including realistic indicators of success and ways to use them to correct problems in the process. Each agency should also evaluate its own process for planning and implementing a project in order to determine critical points of public input, then work with other agencies to develop common procedures. Basic principles to consider include fairness, openness, tangibility, early and continuous participation, and timeliness. Agencies should facilitate sharing of mechanisms, techniques, and information.

Federal agencies should recruit employees skilled at facilitating public participation and at implementing programs that popularize science. Technical specialists and public affairs specialists must work together to articulate in everyday language the problems, plans, benefits, and costs of the ecosystem approach.

Federal programs should strive to include other stakeholders. For example, funds could be allocated for technical assistance to landowners. More technical assistance and information could also be provided to the general public, especially by utilizing existing programs (such as the Wetlands Reserve Program). Education and outreach efforts should be included in budget considerations for projects to implement the ecosystem approach. For increased efficiency, federal agencies could work with 4-H Clubs, universities, and other entities in developing and disseminating education materials to the public. Interpretive materials could be developed on completed projects and projects-in-progress to provide information about what is going on. Citizens have a high level of awareness of problems and issues pertaining to local ecosystems, and agencies should take advantage of this by organizing campaigns in the schools and among adults, or by forming partnerships with schools, landowners, corporations, the tourism industry, and other local residents and stakeholder representatives.

- ***Develop imaginative tools and techniques.*** Tools and techniques for improving the public participation process should be developed and implemented. Public participation should be encouraged by opening the process to as great a diversity and number of people as practically possible. Many mechanisms for increasing public participation can have as much to do with removing practical obstacles as with applying new techniques. For example, meetings can be opened to the public, key contacts can be routinely notified of meetings, information can be gathered from the public, and information can be disseminated to the public through local newspapers and other media. Barriers such as travel distance and

inconvenience of date or time can be overcome through such means as teleconferencing, holding meetings in different places and at convenient times, and establishing distribution networks. Survey team studies identified several other ways to improve public participation:

- *Develop consensus-building techniques.* Use facilitated negotiation and consensus-building techniques to establish a common vision and to resolve conflicts among various interests.
- *Employ new and imaginative public participation techniques.* Use a variety of public participation techniques that go beyond public hearings, comment periods on environmental impact statements, and other traditional methods. The townhall approach can be used, with high-tech tools where appropriate (such as radio and television, satellite downlink, spatial imagery, 1-800 numbers, and Internet). Another idea is to organize regular public forums to discuss ongoing ecosystem efforts. Emphasis should be placed on person-to-person communication—through door-to-door campaigns, surveys, booths at fairs, and similar techniques.
- *Involve the public in decision making.* Involve the public in a wide spectrum of decisions related to the ecosystem approach, including identifying resource needs and priorities, and planning and implementing long-term ecosystem goals.
- *Establish one-stop information centers.* Where resources allow, establish one-stop information centers in rural areas to allow local residents conveniently to obtain and provide ecosystem-related information. Federal agencies could coordinate in establishing such centers, staffing them with people trained to respond to a wide variety of questions on resource-related issues that affect local landowners. Staff should also be able to transfer technology and/or explain environmental publications.
- *Get broad public input.* Go to where people are—to churches, union halls, community centers, and other local community facilities. Whenever possible, assemble those with divergent views so that people can hear what others have to say. Bring together landowners, conservationists, resource users, residents of low-income and minority neighborhoods, representatives of cultural and historical organizations, and the widest possible variety of others in informal, nonthreatening settings with a low-key agency presence.
- *Provide public feedback.* Ensure that the public gets feedback on its comments and suggestions. In addition, the outcome of efforts, including research results, should be disseminated to the public.
- *Use clear language.* Ensure that informational materials are written in plain English, easily understood by the public and, when necessary, translated into other languages.

Chapter 5: SCIENCE AND INFORMATION MANAGEMENT ISSUES

Policy and management decisions are highly dependent on the quality and quantity of information and science available to produce a desired outcome or event. The ecosystem approach means using skill and care in handling integrated units of organisms and their environments to achieve a desired outcome—the shared vision for the ecosystem. Developing the foundation for the ecosystem approach requires not only *sound* science, but also the *right* science—knowing and understanding how major ecosystems function, how they support and tolerate human use, and how policies and management decisions affect resource use, environmental impacts, and recovery.

Better scientific knowledge can greatly improve the development, implementation, and assessment of policies and programs. Agency managers need this information in order to implement more effective policies. Decision makers are turning to science more frequently for credible technical guidelines to resolve management and policy problems. In addition, an increasingly involved and informed public is challenging the technical credibility of conservation plans and decisions, making it critical that the most scientifically sound information is available to all stakeholders.

A sound science that is the right science—this provides the basis for the ecosystem approach. The ecosystem approach is not a linear, highly standardized, or certain means to identify the one right way to manage resources. Instead, it aids in the development of better options and sustainable solutions by incorporating human needs and values with our best understanding of the environment, while recognizing that science alone has not and will not produce a single “right” answer for resource use and management objectives. Instead, decisions will continue to be a complex blending of social, economic, political, and scientific information and interests, as illustrated in Science Success Story 1.

The Science and Information issues group has identified opportunities for and constraints to the use of science for the ecosystem approach, and developed recommendations to increase agency science, technology, and information efforts to improve:

- The potential for interagency collaboration.
- The involvement of nonfederal interests (consistent with the Federal Advisory Committee Act).
- The credibility of the science and information bases used for decisions.
- The availability of information to decision makers, scientists, and the public.
- The development of new ecosystem-oriented adaptive management strategies.

The group’s approach was to: (1) identify general phases and activities for collecting, managing, assessing, delivering/displaying, and augmenting information relevant to the ecosystem approach; (2) articulate preferred strategies/solutions for addressing those phases and activities that facilitate common approaches wherever possible; and (3) develop a framework for research and development for the ecosystem approach. The effort of this issues group was closely linked to the efforts of the National Science and Technology Council’s (NSTC’s) Committee on the Environment and Natural Resources (CENR). The group examined priorities for the science and information management necessary for the implementation of the ecosystem approach and links them with priorities developed in the NSTC/CENR process. The research strategies and implementation plans developed by the NSTC/CENR subcommittees and crosscutting issue groups* address policy relevant to science priorities in their respective areas.

In preparing this chapter, the Science and Information issues group carefully reviewed seven case studies in the ecosystem approach (see volume 3 of this series, *Interagency Ecosystem*

*These include subcommittees on: Social and Economic Sciences Research; Technology and Engineering Research; Risk Assessment; Information Management; Global Change Research; Biodiversity and Ecosystem Dynamics Research; Resource Use and Management Research; Water Resources/Coastal and Marine Environments Research; Air Quality Research; Toxic Substances and Hazardous and Solid Waste Research; and Natural Disasters Research.

Science Success Story 1. Ouachita Ecosystem Management Research Project

Objective: To generate public acceptance, management innovation, a productive research environment, and research support for the ecosystem approach in the interior highlands of Arkansas and Oklahoma.

Background: In August 1990, the Forest Service discontinued clearcutting as the primary tool for harvesting and regenerating shortleaf pine and shortleaf pine-hardwood forests on the Ouachita National Forest. To evaluate new management methods for this ecosystem, a unique partnership of researchers and managers was formed—the Ouachita Mountains Ecosystem Management Research Team.

Collaborators: Managers and researchers from the Ouachita and Ozark National Forests and the Forest Service's Southern Forest Experiment Station.

Implementation: The project is being conducted in three phases: a stand-level demonstration project; a stand-level research program; and a landscape-level application of results obtained from the research.

Learning Points: Managers learned about the constraints necessary to maintain scientific rigor and the limits of legitimate scientific inference. Researchers learned about the legal and budgetary constraints managers face. Both realized that working collaboratively, but toward different goals, can produce creative tension.

In the process, the area of detailed descriptive ecology was identified, encompassing the analysis of soils, water, invertebrates, avian populations, and other ecosystem elements. To managers, this information may be necessary to supplement published studies, yet few managers have the time or expertise to rigorously design and analyze complex data. Generally, researchers have not been eager to fill this role, because the results are rarely publishable.

Management Task Force 1995). This chapter summarizes the group's impressions and analysis of comments made by interviewees during the case studies. Recommendations based on these interviews are presented at the end of this chapter.

ROLE OF SCIENCE AND INFORMATION MANAGEMENT IN THE ECOSYSTEM APPROACH

Why is science important? Sound ecosystem science supports sound ecosystem policy. Gaps in the science base undermine federal policies and decisions, creating a critical situation as our environment becomes less resilient to impacts. The science base must be able to withstand legal challenges and should be objective and independent in the development of policy or management alternatives.

It must assess ecological, social, and economic considerations in order to successfully support the ecosystem approach.

What are the roles of science? It is expected to contribute technical answers and insights and suggest reasonable solutions that recognize uncertainty so that responsible resource policies and management solutions can be developed and implemented (box 1). However, uncertainty

surrounding environmental issues abounds and new questions are continuously generated. This uncertainty must be built into policymaking, planning, implementation, and management. It is important that scientific investigation be relevant to policy and management needs, but it is also essential to continue to support some fundamental science and to recognize that science will not always have the answers.

Ecosystem science is complicated by the need to integrate expanding information on a myriad of biological, physical, and social aspects related to an ecosystem and its associated attributes. A sound technical information base is essential for developing resource policy that best blends competing interests so that economic development and resource conservation are sustained. Science is needed to assess and monitor resource conditions, and to develop and recommend ways to manage ecosystems at various spatial and temporal scales.

New management systems and resource policies must also be monitored and evaluated so that they can be adapted to achieve their purpose.

Science plays a key role in the implementation of the ecosystem approach (see box 2). The importance of these issues identified in the case studies is illustrated by their potential roles in the ecosystem management process (table 1).

Box 1. Critical Roles of Science in the Ecosystem Approach

A sound science base helps decision makers improve their understanding of:

- The extent of ecological assets and to distinguish between those that are renewable and nonrenewable.
- The full range of social and economic interrelationships with, uses of, and dependency upon the ecosystem.
- The impacts of human activities upon the ecosystem.
- The processes and time lines for recovery associated with renewable ecological assets.
- The positive and negative effects of policies and management actions on the ecosystem.
- How use appropriate technology for ecosystem recovery and restoration.
- How to use science to support decisions in the face of legal and public challenges.
- How to communicate the scientific basis for policies and decisions to stakeholders and the general public.
- How to use science as a basis for partnership.
- The uncertainty that may be present in any action or decision, and that the degree of uncertainty should be verified scientifically wherever possible.
- How to use science to monitor and evaluate the success of the ecosystem approach.

Box 2. Steps Under the Ecosystem Approach Requiring Sound Science

1. Defining the area of concern/interest.
2. Developing, together with all stakeholders, a shared vision of the ecosystem's desired future condition.
3. Characterizing the historical ecosystem and its present economic, environmental, and social conditions and trends.
4. Establishing, together with all stakeholders, ecosystem goals and objectives.
5. Developing and implementing, in cooperation with all stakeholders, an action plan based on selected alternatives for achieving the goals.
6. Monitoring and evaluating outcomes.
7. Adapting management according to new information.

Table 1.— Importance of science in the ecosystem approach

Issues and gaps	Steps in the ecosystem approach ^a						
	1	2	3	4	5	6	7
Ecology on multiple scales	E ^b	E	E	E	—	E	E
Multiple-species science	—	H	E	H	—	E	E
Monitoring and evaluation	H	H	—	—	E	E	E
Benchmarks/indicators	—	—	H	H	E	E	—
Socioeconomic science	E	E	E	E	E	H	E
Human dimensions	E	—	H	E	E	H	E
Ecorestoration techniques	—	—	H	H	E	—	E
Quantifying uncertainty/risk	—	—	H	E	—	—	—
Modeling	H	H	H	E	E	—	—
Adaptive management	—	—	—	E	E	—	E
Information management systems	—	—	—	—	H	E	E
Synthesis/assessments	H	E	—	H	H	—	—

a. 1 = Define the area of interest. 2 = Develop a shared vision of the ecosystem's desired future condition with all stakeholders. 3 = Characterize the historical ecosystem and the present economic, environmental, and social conditions and trends for the ecosystem. 4 = Establish ecosystem goals and objectives with all stakeholders. 5 = Develop and implement an action plan based on selected alternatives for achieving the goals in cooperation with all stakeholders. 6 = Monitor and evaluate outcomes. 7 = Adapt management according to new information.

b. E = Essential information. H = Helpful information.

HOW SCIENCE IS CONDUCTED AND SCIENTISTS INTERACT

Scientific support for ecosystem management decisions requires much more integration than is currently common within the scientific community. This integration must take place between scientists in different disciplines (including the social and economic sciences as well as the physical and biological sciences) and in different agencies, between scientists and managers or decision makers, and between the data and information systems used by both groups. This need parallels that for greater collaboration among the various sectors and parties involved in ecosystem management and decision making.

Several infrastructure-related issues reduce the quality, quantity, or relevance of current scientific efforts to the ecosystem approach. These include the current skills mix within the federal science establishment, which may reduce the ability to focus on new issues; and the historic undervaluing of long-term monitoring and assessment, which hinders developing a long-term perspective on human and natural change that is critical to the ecosystem approach. All of these issues were identified as potential problems in implementing the ecosystem approach in the seven case studies (see volume 3 of this series, Interagency Ecosystem Management Task Force 1995).

INTERACTION AMONG SCIENTISTS, MANAGERS, AND THE PUBLIC

An ecosystem approach requires that natural resource managers, scientists, and the public share a vision for the future of a world in which societal and economic decisions are consolidated with an increasingly comprehensive, integrated understanding of the environment. Essential to this approach is ensuring that economic development in the United States is managed to maintain biodiversity and long-term productivity for our nation's natural resources and ecosystems. Partnerships among federal and state agencies can help integrate management operations into an ecosystem-wide approach, collaborate in monitoring efforts and assessments to give better information to decision makers, provide education and outreach to increase public understanding, and take a more

proactive approach to understanding and maintaining biodiversity.

Need for Collaboration

In order to move toward this vision, the paradigm for managing natural resources and ecosystem health must shift from a fragmented to an integrated multidisciplinary approach, from a site-specific to an ecosystem-wide (spatial/landscape) context, and from a reactive to a proactive mode. To implement this approach, comparative ecosystem (i.e., regional, watershed) management activities that will reduce the cumulative effects of ecosystem stress must be undertaken. Initially, attention should be focused on a limited number of key ecosystems to demonstrate the capabilities and benefits of a science-based integrated ecosystem approach. By 1999, several representative ecosystems should be included.

Several tasks that are part of the ecosystem approach must be addressed more vigorously—tasks that are now limited in knowledge and resources: (1) nonpoint source management strategies; (2) assessments and forecasts of economic conditions, land use patterns, contaminant sources, habitat management needs, and ecological resources at risk; (3) development of comprehensive regional information systems to support decision making at the ecosystem level; (4) development of protocols and technologies for monitoring at the ecosystem level; (5) development/enhancement of the ability to construct predictive and management support models at multiple scales; (6) involvement of the public and decision makers in designing research and monitoring projects; (7) active translation and dissemination of new information to the public, as well as to management and policy officials, to ensure that economic development can be pursued without sacrificing ecosystem health; and (8) implementation and field testing of management strategies.

The need for better management of natural and manmade landscapes is inescapable. Ludwig and others (1993) have observed that "there is remarkable consistency in the history of resource exploitation: resources are inevitably over-exploited, often to the point of collapse or extinction." Several reasons were given for this consistency, including wealth or prospect of wealth-generating

power, the difficulty in reaching a consensus on scientific understanding, and the enormous complexity and inherent variability of natural systems. One of the key recommendations offered by Ludwig and others (1993) for future natural resource management principles is to include human motivation and responses as part of the system to be studied and managed. Although these aspects are critically important, the scientific approach must be coupled with the development of improved management strategies in order to fully sustain vital ecological systems. Efforts by the Ecological Society of America to set research priorities for the next decade resulted in the setting of research

priorities for the next decade in "Sustainable Biosphere Initiative: An Ecological Research Agenda" (Lubchenco and others 1991). This agenda identified three priority areas for ecological research: global change, biological diversity, and sustainability of ecological systems. An important caveat, however, is that science-based management studies and policies will be useful only if they include the involvement of all players, such as decision makers, economists, sociologists, and user groups. Uncertainty or lack of information inhibits both management and political action (see Science Success Story 2).

Science Success Story 2. Mammoth Cave Area Biosphere Reserve

Objectives:

- To develop a land ethic based on wisely managed natural and cultural resources.
- To identify long-term, sustainable, and ecologically sound economic development opportunities.
- To encourage research and demonstration projects that contribute to sustainable development, agriculture, and the ecosystem approach; and to develop educational programs about the Man and the Biosphere program.

Background: The Mammoth Cave Area Biosphere Reserve in Barren, Edmonson, and Hart Counties, Kentucky, includes the longest known cave in the world. Decades ago, Mammoth Cave National Park, the core of the Biosphere Reserve, and other organizations initiated long-term hydrological and ecosystem research in the region, producing an accurate map of the ground water basin and permitting natural or human-induced changes to these underground resources to be monitored, detected, and understood. The substantial knowledge base developed by this body of research is used extensively in planning development projects in the zone of cooperation, which conforms to the ground water recharge area for the park's cave.

The principal economic issues driving development planning in this rural area are sustainable agriculture and sustainable development of small, tourist-oriented businesses and light industry. The Barren River Area Development District, which was established by state statute and covers 10 counties, is composed of local officials and representatives of economic interests and human welfare. The District serves as secretariat for the Mammoth Cave Area Biosphere Reserve, and the Cooperative is an adjunct to the Natural Resources Planning Council of the Development District.

Collaborators: The Cooperative brings federal, state, and local agencies together with local landowners and citizens to support collaborative projects that address effects of regional land use and development on surface and ground water resources.

Implementation: The Cooperative encourages participants to understand the Biosphere Reserve as an ecological, economic, and cultural area and to use consultation, cooperation, and good information as the guideposts for management and development. The Biosphere Reserve program has facilitated development of a regional geographic information system, water quality monitoring, cultural heritage assessment, environmental education, and a resource conservation and development area that seeks to improve general welfare by developing rural water and sewage systems, encouraging best management practices, and enhancing adult and environmental education. The Cooperative and the Economic Development Administration have conducted an economic impact study to assess the potential for sustainable industrial development along the I-65 transportation corridor. It has facilitated infusion of funding from the Natural Resources Conservation Service and Agriculture Stabilization and Conservation Service to mitigate nonpoint sources of water pollution by encouraging construction of onfarm best management practices systems to contain pesticides and recycle animal wastes.

Benefits: The Biosphere Reserve program has:

- Encouraged stakeholders—federal, state, and local governments and citizens—to join in partnerships to support the ecosystem approach and sustainable development.
- Nurtured the community's environmental ethic, partly by educating residents about what ground water is and where it goes.
- Gained public acceptance and attracted local participation by developing as a Cooperative rather than a federal program, and by attempting to meet the needs of the entire region.
- Brought local individuals and communities to perceive the federal presence as demonstrating open, honest government.

Constraints to Collaboration

The ecosystem approach faces several science-related constraints to collaboration: tenuous relations of scientists with managers and the public; nonscience factors that impede a management-oriented science; scientific priorities that are driven by politics and public pressure; and the scarcity of a truly management-oriented science.

Poor relations. There are poor or tenuous connections between managers and scientists, and between scientists and the public, due to the following barriers:

- There is a lack of mechanisms for data and information exchange between managers, policymakers, scientists, nongovernmental organizations (NGOs), and other interest groups.
- Results of science studies are often not transferred to managers and policymakers in a user-friendly format.
- Managers and the public are rarely included in designing scientific studies to ensure products will be useful in their decision-making processes.
- There are not enough specialists who are capable of translating technical information to managers and the public, as well as expressing management and policy needs/gaps in a scientific forum.
- Managers are often not interested in participating in scientific design or in reading and interpreting research results.
- Scientists are often not interested in participating in the development of management objectives and/or the design of programs.

Nonscience variables. Management-oriented science is impeded by nonscience variables, including federal budget and funding processes, legal concerns, and lack of adequate public education.

Funding barriers. Of the many budget-related barriers to the ecosystem approach, lack of interagency cooperation in budget planning for scientific programs is often mentioned. In addition, overall funding for environmental trend analyses is sparse,

and it is difficult to secure funds for large-scale restoration and ecosystem management projects. Agencies should develop coordinated, long-term budget initiatives that focus on science oriented toward the ecosystem approach. Increasing agency support of investigator-initiated research (that is, basic research supported through grants) would seem, on its face, to facilitate the needed defensible and credible science. On closer inspection, however, the grants mechanism may not be designed to meet the need for research driven by the critical issues and problems faced by managers and decision makers.

Legal barriers. Legal concerns include the Federal Advisory Committee Act, which restricts the ability of federal agencies to solicit and receive collective advice from nonfederal parties. Among other things, an advisory committee as defined by the Act must be organized under a charter, balance its membership, notice its meetings in the Federal Register, hold open meetings, take minutes of meetings, and provide transcripts of meetings upon request. The federal government cannot achieve its goals without integrating its activities with other key federal and nonfederal players in the ecosystem. Coordination is also critical to information sharing and joint scientific research. The lack of routine and formalized communication between federal and nonfederal parties is one of the biggest barriers to efficient ecosystem restoration and management.

Educational barriers. A strong public education program will help private landowners understand the ecosystem approach's role in determining the health of ecosystems encompassed within their private lands, and the connection between their lands and those outside of their property. Private landowners vary in their willingness to permit inventory and monitoring activities on their lands. They fear that information about their lands could become public against their will and that remote sensing could be used to survey their lands without their knowledge or consent. Lack of information about private lands could hamper the ability to perform cumulative effects analyses that are important for effective decision making under the ecosystem approach. Education and implementation of demonstration sites on public lands may ease the transfer of conceptual plans into prototype management programs on adjacent nonpublic lands within the ecosystem management unit. The true test of our ability to monitor and model biological

responses to human activities will be their adoption by federal and state agencies who manage public lands, industry, and private landowners who manage private lands.

Politics and public pressure. Politics and public pressure drive priorities of science support and resource management policy. Barriers include fragmentation and regionalization in agenda setting, evaluation and acceptance of risk and uncertainty by nonscientists, and the need to balance science with other issues.

Fragmentation and regionalization. Single-objective, single-site management often results in fragmentation of larger scale objectives. Natural resource decisions traditionally have emphasized achieving the management goals of a particular agency, organization, or interest group in addressing particular human needs (such as timber, water, fisheries, or recreation) in a particular management unit (such as public rangelands or water management districts). In recent years, the limitations of this approach have become obvious as competition for available resources has increased. Scientific evidence has cast doubt as to the sustainability of many current natural resource uses and management practices. The need for greater public participation and cooperation among all affected parties—federal, state, and local government; academic institutions; private industry; and interest groups—in developing and implementing natural resource use and management goals is fundamental to designing and achieving sustainability and protecting natural ecosystems.

Ecological risk assessment. We must develop criteria and indicators for ecological risk assessment that are commensurate with broad policy goals, including protecting environmental health, stewardship, and the sustainability of current and future ecosystems and their services. Indicators for the criteria should be amenable to measurement and prediction, and should reflect structural and functional interrelationships within ecosystems. Risk assessment must better account for the ecological value that is lost or maintained as a result of human activities.

Balancing issues. Many of today's arguments for integrating economic concerns into species conservation decisions focus only on the short-term and local tradeoffs. We must develop balancing mechanisms that are capable of considering both

long-term and geographically comprehensive consequences. It also seems important to spread the risks of species conservation more broadly, so that local communities and landowners do not incur the sometimes heavy burden of conservation requirements that are intended to benefit the entire nation. It behooves us to consider and adopt innovative, progressive approaches—such as the ecosystem approach—when trying to find this balance.

Rarity of management-oriented science. There are several barriers to management-oriented science: lack of interdisciplinary teams; the fact that applied research and technical development are not a priority within the research community, and a lack of incentives for scientists to do technical transfer; the fact that commitments to long-term monitoring and assessment are exceptions; and the fact that focused management-oriented research is generally reactive instead of proactive.

Interdisciplinary teams. In order to protect and manage our natural resources, we must understand the interaction between natural factors and human activities so we can determine changes in biota and the ecosystems on which they depend. This requires a team approach to research questions rather than a narrow, single-discipline focus. Teams must provide the scientific basis for explaining trends in biological diversity. We must increase efforts to understand the environmental, ecological, and evolutionary processes that generate and maintain biological diversity, sustain viable species populations, and support ecosystem structure and function. These efforts will produce a clearer picture of how natural factors interact with human activities at landscape to regional levels to determine status, change, and trends in biodiversity and ecosystem function. Through selected biological and ecosystem indicators, these research efforts will also help determine what roles individual species and species diversity play in ecosystems.

Applied research and technology transfer. To advance technical development, scientists must be encouraged to conduct applied research and at least partially evaluated for their technology transfer efforts. To facilitate the incorporation of new and existing knowledge into management and policy decisions, we must provide user-friendly information and validated analytical models that can be used to explore the possible consequences of alternative management and policy decisions.

Ultimate goals of all of these studies and activities will be: to obtain (and improve) the scientific bases required for a sound ecosystem approach; to develop practices and policies for responsible prospecting for and utilizing biodiversity; and to develop methods, including improved ecological risk assessment, to conserve and restore biodiversity and ecosystem dynamics in compromised ecosystems. The full spectrum of data and information needed to better understand and conserve biodiversity and ecosystem processes must be available and accessible to scientists, decision makers, and the public.

Monitoring and assessment. Much of the earth's diverse biota and ecological processes remain undiscovered and undescribed. For those species that have been described, we know little about the broad-scale trends in their abundance and distribution. To address these deficiencies, we need national and international efforts to discover, describe, inventory, and monitor the world's organisms to provide the fundamental information base for monitoring and surveying biological diversity. We will be more capable of explaining observed biotic and ecosystem trends when we have a scientific and statistically reliable picture of them across large geographic areas.

Proactive management-oriented research. The understanding and models produced by the efforts described above will be useful in predicting how a wide range of species and other indicators of ecosystem status will respond to alternative management and policy decisions. Models are never perfect, and resource managers will be hesitant to adopt unproved models for real-world application. The true test of our ability to monitor and model biological responses to human activities will be when the federal and state agencies who manage public lands, and industries, and private landowners who manage private lands adopt these models and their modifications. Such a model should be initially used in the context of an adaptive management loop, where it is viewed as tentative and the management decisions are viewed as experimental tests of the models. The models predict trends of population and ecosystem indicators, which are then monitored and compared to model predictions. Based on the discrepancies observed, a model is continually updated, refined, and used as the basis for additional management decisions.

IMPLEMENTATION OF ADAPTIVE MANAGEMENT

Adaptive management accepts the fact that the information used in making decisions is imperfect and that, as decisions are implemented, there must be an established method for gaining better information and adjusting the implemented action accordingly. This structure consists of models, special studies, and monitoring that are used as coordinated, supportive tools.

Feedback between managers and scientists and between the public and scientists is a fundamental component of the adaptive management strategy, and periodic assessment is its operational foundation. In adaptive management, models and monitoring are applied within the framework of an assessment protocol, which helps focus monitoring efforts and define how models will be applied at various stages in management. Ecological indicators are used to evaluate and, when fed into appropriate models, help select among management alternatives. A baseline condition is determined for the same indicators, using monitoring before management strategies are implemented. Then the same indicators, which continue to be monitored after the new management strategies are in place, are used to assess the effect of a management action. To be effective, ecological indicators must be practical, sensitive, and capable of being both monitored and modeled.

It is almost a truism that any important policy decision is better with stronger information behind it. Three main factors have inhibited the integration of science into the decision-making process: (1) decision makers have not always been aware of how or when research might be useful to them; (2) in the past, decision makers have been reluctant to ask researchers for help because it meant acknowledging uncertainty, or worse, relinquishing some power by reducing the range for their discretion; and (3) basic research is not always designed to answer management and policy questions. Science makes two significant contributions to the decision-making process. First, it allows decisions to be based on past experience and knowledge. Second, ignorance can be confronted because it has been explicitly recognized. Because of this, policy must be cautious and flexible (maybe even reversible). Programs that result from the policy

could be designed specifically to capture the knowledge that is needed. Policies relating to such a difficult concept as biodiversity must have an iterative adaptive management strategy that permits feedback and modifications. Incorporating evaluation mechanisms that allow policies, programs, and performance to be assessed encourages agency officials to be prudent and responsive. Using scientific information tends to push decision makers towards moderation and towards policies and programs that are more likely to work.

In an adaptive management approach, the challenges to justifying and designing experimental management programs are:

- To demonstrate that a substantial, deliberate change in policy should even be considered, given the alternative of pretending certainty and waiting for nature to expose any gaps in understanding.
- To expose uncertainties (in the form of alternative working hypotheses) and management decisions in a format that will promote both intelligent choice and a search for imaginative and safe experimental options, by using statistical decision analysis.
- To identify experimental designs that clearly distinguish between localized and large-scale effects, and hence capitalize on opportunities for replication and comparison.
- To develop designs that will permit concise assessment of transient responses to policy changes in the face of uncontrolled environmental factors that may affect treated and reference experimental units differently.
- To develop ways to set priorities for investments in research, management, and monitoring, and for designing institutional arrangements that will be in place long enough to measure large-scale responses that may take several decades to unfold.

Adaptive management is a continuing process of active planning, monitoring, evaluating, and adjusting that aims to improve the implementation and achievement of desired goals and outcomes. The process itself is straightforward and simple: new information is identified and evaluated, then strategy or goals are adjusted accordingly. The

core of any regional program for in situ conservation is a long-term inventory, research, and monitoring effort that in turn informs adaptive management.

Whereas the concept of adaptive management is relatively straightforward, applying it to complex management strategies requires answers to several critical questions:

- What new information should compel an adjustment to the management strategy?
- What threshold should trigger this adjustment?
- Who will decide when and how to make adjustments?
- What are the definitions and thresholds of acceptable results?

Adaptive management under the ecosystem approach depends on a continually evolving understanding of cause-and-effect relationships in biological, physical, and social systems. It proposes to treat policies as experiments, and collect information so that the execution of policy can help identify surprises, improve operations, and gauge the policy's success while it is implemented. Uncertainty creates the need for flexible, adaptable institutions that are capable of incorporating and responding to a diversity of new information. Adaptive management has large implications for the resource planning process. Management activities must be designed so that everything can be evaluated. Plans should have no tenure, i.e., the focus should be on endpoints and on developing a set of working principles. Milestones should be developed to assess progress to those endpoints. Resource monitoring must answer the questions we want answered and those questions dealing with compliance issues. Adaptive management strategy calls for the development of risk assessment methodologies that determine the limits of uncertainty used for triggering actions that reach threshold levels.

The key features in an adaptive approach are:

1. **An experimental design for implementation.** Adaptive management demands taking a rigorous scientific approach to management. Holling (1978) noted that the

“heart of adaptive environmental management” is “an interactive process using techniques that not only reduce uncertainty but also benefit from it. The goal is to develop more resilient policies.” Experiments that produce information should be a significant part of actual management activities. Adaptive management can be effective only if monitoring and evaluation procedures are integral parts of the design that are incorporated from inception and not simply added after implementation.

2. ***An explicit description of the system.*** To answer critical questions about resource management, we must have a comprehensive understanding of the current ecological conditions of ecosystems of interest, changes in the ecosystem components over time, and their likely ecological trends. Therefore, we must assess the social, biological, chemical, and physical components of the management area so we can fit them into the larger ecological context.
3. ***Well-defined goals and objectives.*** The planning process, which is a collaborative and cooperative approach, uses the assessment to assign values to the current condition and describes the desired future condition of the resources. There is likely to be an inappropriate decision without widespread understanding and acceptance of the desired future condition. Two relevant working hypotheses are: (1) human values and expectations can be incorporated into the ecosystem approach by identifying landscape patterns that are representative of these values; and (2) sustainable ecosystems can be achieved by integrating people's expectations with the ecological capacities of ecosystems.
4. ***Identification of critical uncertainties.*** It is known that all decisions have a certain amount of uncertainty involved, due to imperfect or dated information, that may cause unacceptable results. To minimize the impact of unacceptable outcomes, decision makers must focus on critical uncertainties. This can be accomplished by collecting the best information available and tracking and evaluating decisions throughout the process.

5. ***A monitoring and evaluation program.***

Monitoring is needed to determine whether management actions have placed an ecosystem on the proper trajectory towards an agreed-upon desired future condition. But what new information should trigger a change in strategy or direction? New information can come from monitoring, statutory or regulatory changes, organizational or process assessments, or a variety of other sources. The measurable indicators of progress along a trajectory will vary, depending on the starting point and the targeted condition. There are two distinct phases in a monitoring and evaluation program. (1) Traditionally, the first phase monitors and evaluates the consequences of management actions. It constantly measures progress towards the stated desired future ecological condition and permits mitigation when actions leave course. During the evaluation process, information is analyzed to determine its nature, scope, and importance. Adaptive management depends on negative and positive feedback from the evaluation of both the continued desirability of previously selected management goals and progress toward their achievement. If the impacts detected during monitoring and evaluation are insignificant, then the management regime can be refined without adjusting the long-term plan. If, however, the impacts are significant, the plan must be revised. This can be done directly or, if needed, by incorporating new knowledge, changed social values, impacted environments, and similar factors into modifications to the assessment. (2) The second, less traditional, phase monitors and evaluates social needs in relation to changing societal values and settings. These are constantly assessed against the desired future ecological condition, recognizing that societal values often change more rapidly than ecological conditions.

The evaluation of monitoring data provides feedback not only on management practices, but also on research needs. Unless research is an integral part of the adaptive management loop, the continual improvement of management actions is reduced to little more than a trial-and-error process.

6. **An aggressive approach to learning.** As noted above, the less traditional approach to monitoring and evaluation requires active learning in all aspects of the ecosystem approach. Resource managers and scientists must learn more about the social, biological, and physical attributes of ecosystems and adapt more quickly to new knowledge. This requires that technology transfer must be an inherent and valued part of the ecosystem approach.
7. **An adaptable structure.** Lastly, the adaptive management structure itself must be inherently adaptive, which includes the organization responsible for implementing the process. The key element in this flexibility is the development of a management system that operates strategically and not functionally. This system emphasizes functional skills and eliminates functional or organizational barriers.

As prescribed in the President's Forest Plan, in the Pacific Northwest adaptive management is the structure through which research, management, and cooperators work to achieve the general Plan objectives. The Forest Plan proposes 10 adaptive management areas, in which opportunities are provided for federal, state, and local officials, industry, community and environmental organizations, tribes, and others to work together to develop innovative management approaches. Examples include the Applegate Project, the Douglas Project, and the Central Cascades Adaptive Management Area in Oregon, and the Hayfork Adaptive Management Area in northern California. These areas provide for intensive experimentation, development of innovative ways to achieve ecological, economic, and social objectives, and local involvement in defining the future. Their overarching objective is to improve our knowledge of how to implement the ecosystem approach by using an iterative refinement of management strategies that is closely monitored over time.

A Forest Ecosystem Management Assessment Team working group has developed the adaptive management process to the point that it is now ready for prototype testing on sample watersheds. Researchers must be deeply involved in the monitoring program for the successful implementation of the Forest Plan. They are helping to develop

protocols and implement monitoring plans, helping to develop information storage systems, and providing systems and/or expertise to synthesize and evaluate the information as it is collected. Monitoring programs are being approached with caution to ensure that they are both scientifically and legally defensible, and are adequately funded over their life to ensure reliability of results. Research is helping to define the sideboards of what is possible in order to give managers the bounds of their decision space.

SUBSTANTIVE SCIENCE AND INFORMATION MANAGEMENT GAPS

In order to support the ecosystem approach, it is necessary to understand how ecosystems work and have knowledge of ecological structure, process, natural variability, vulnerability to stress, and potential for recovery, at multiple scales in space and in time. The narrow focus of most ecological research conducted over short periods and on very localized, site-specific scales has created a fundamental gap in understanding the way that larger systems function over longer periods of time. Such knowledge is crucial to a long-term, sustainable ecosystem approach. Adaptive management, which permits action while concurrently increasing our scientific understanding, is necessary because of our current limited understanding of large ecosystems.

Science Issues and Gaps

Although the seven ecosystems that were studied are very different (see Interagency Ecosystem Management Task Force 1995, volume 3), the issues concerning their supporting science are similar. In addition to the limitations of scientific understanding, methods, and technology, there are other contributing factors for the gaps in the science base. Budget constraints, political and organizational influences, conventions of higher education, and inadequate communications influence and shape the strengths and weaknesses of the ecological science base. The lesson learned through this observation is that, whereas it is important to identify key scientific gaps, the barriers and the solutions to these problems often may be more social or institutional than scientific in nature. Following are some of the recurrent science issues encountered in the interviews.

Ecology on multiple scales. There is a well-known discrepancy between the typically very small scale of species or habitat-specific ecological research projects and the larger geographic scales upon which ecosystems are managed. More than 70 percent of published ecological research has been conducted on sample sites of a square meter or less, yet environmental management in general focuses on geographic units such as whole watersheds, coastal zones, or national forests or parks. Highly localized studies are necessary for understanding some of the functions of larger ecosystems, but there is also a need to understand ecosystem processes on greater scales. This situation, however, is changing through the pronounced increase in applied research in areas such as watershed analysis and landscape ecology. Federal agencies have the opportunity to guide research in these fields toward the directions most

needed to support the ecosystem approach, and some of these opportunities are already being exploited.

Multiple species science. There is a great deal known about the biology of single species, but very little about the interactions between species, groups of species, and the habitats that support them. Managing for a single species, such as for maximum harvest for food or fiber, has often harmed other species and ecosystem functions. To improve our ability to model the effects of possible management decisions on wildlife and fish populations requires a much better understanding of what determines habitat quality; how it is created, maintained, restored, and destroyed; the timing and effects of natural variability; and how human activity alters habitat suitability (see Science Success Story 3).

Science Success Story 3. Gap Analysis Program

Objective: To conserve biodiversity and ecosystem functions by facilitating landscape-level planning and management of public lands through protection and restoration of ecosystems.

Background: Studies of biodiversity begun in FY 1988 indicated that centers of greatest biodiversity are frequently unprotected, whereas the most protected lands rank low in biodiversity. The Gap Analysis Program complements species-by-species techniques for wildlife and fisheries management by using geographic information systems to identify unprotected lands of ecological significance, and by linking discrete ecological models and spatial data bases to develop detailed pictures of how ecosystems might perform under a variety of human-induced perturbations.

Collaborators: Coordinated by the National Biological Service, the Gap Analysis Program involves cooperative working arrangements among more than 200 federal, state, and private organizations. Partners include the Environmental Protection Agency, U.S. Department of Defense, Fish and Wildlife Service, National Park Service, U.S. Department of Agriculture, Bureau of Land Management, states, The Nature Conservancy, IBM, Pacific Gas & Electric, museums, and Hoffman Associates. The National Biological Survey has asked the U.S. Geological Survey for assistance in cataloging, indexing, and maintaining geographic information system data for access by state, local, and private users.

Implementation: Through partnerships, the Gap Analysis Program is integrating other geographic information system efforts, resulting in a standardized geographic information system classification of vegetation types. Gap Analysis is currently being conducted in 36 states covering 10 major ecological regions, including the Pacific Northwest, Mojave Desert, Great Basin, Rocky Mountains, and southern California. Gap Analysis Program data are being used at state, federal, and local levels to make decisions on land management, including siting of military maneuvers, evaluation of new national park proposals, and evaluations of existing wilderness proposals. In California, Gap Analysis Program data have been used to evaluate local government zoning for protection of biodiversity.

Benefits: Landscape-level analysis provided by the Gap Analysis Program enables managers to take a broader view of ecosystems and habitats, emphasizing creation of self-sustaining populations within a healthy landscape. The prudent use of information provided by the Gap Analysis Program is expected to provide long-term reduction in the listing of endangered species, and cost savings for the development and conservation sectors.

Monitoring and evaluation. Ecological monitoring is an indispensable part of the ecosystem approach because it provides periodic feedback on how management policies and techniques are working, whether there is regulatory compliance, and when adaptive management changes should occur. However, there are several shortcomings to ecological monitoring methods and data. Problems with methods include a shortage of accepted monitoring protocols and the limited applicability of

existing monitoring programs to whole ecosystem health and sustainability on middle to large scales. The limited investment in baseline monitoring restricts our ability to observe trends in degradation or recovery, and our ability to predict future ecosystem condition and responses to management actions.

Better monitoring science has been limited by the minimal recognition of its importance by decision

makers and subsequent underfunding. Other barriers include limited interest from the scientific community as compared to research, and the relative difficulty of fitting monitoring into the typical graduate degree program. Managers and decision makers must understand the critical role of ecological monitoring. There should also be cooperation with educational institutions and the scientific community at large to improve the monitoring infrastructure. Key roles for monitoring should include determining whether restoration projects are designed according to specifications, whether the project or management measure is functioning as expected, whether adjustments for unforeseen circumstances are needed, whether a different management approach is necessary, and trends in indicators of ecosystem conditions.

"Benchmarks" of ecosystem conditions. There is a shortage of information and methods for comparing degraded ecosystems with fully functional ecosystems. These "benchmarks" include fully functional reference sites, measurable indicators of ecosystem conditions, and ways to measure progress under the ecosystem approach and to determine the need for modifications. Indicators and measures of progress are crucial for research and development. Because there will be regional differences in indicators of ecosystem health, research must be regionally specific and probably often best collocated with a local center of ecosystem management activity. Too often a benchmark is mistaken for a fixed value, so it is essential to get a measure of its variability. When monitoring, this is the only way to assess if a change from the baseline is statistically significant and worth a reaction. For example, often the annual variation in an environmental parameter is very large and indicates less about ecosystem status than it does about climatic fluctuations.

Socioeconomic sciences and valuation. The ecosystem approach is complicated by the need to integrate information on myriad biological, physical and socioeconomic concerns. Sound yet innovative documentation and evaluation of ecosystem socioeconomic elements are essential for developing management strategies and making decisions that weigh all relevant, competing interests and balance ecosystem functions and economic activities. A primary barrier has been the markedly different perceptions of natural resource commodities evident in traditional and ecological economics. At the heart of the conflict over natural resource

management is the difficulty in determining values that different individuals and groups assign to various resources. Research needs in this area include: economic and noneconomic benefits; demographic measures; formation and modification of values; and costs/pricing techniques. Moreover, even though there have been exhaustive arguments for supporting science, the necessary support has not been forthcoming. With increases in funding and level of interest in valuation methods and principles, this can become a more influential facet in the development of principles and practices under the ecosystem approach. We need to demonstrate the use of these methods in evaluation and decision making.

Human dimensions of natural resource use.

Ecosystem approach objectives must integrate multiple resource use objectives. As we look to the future of natural resource management, it is clear that people are at the center of the debate, because human needs drive the use and misuse of these resources. Our efforts to understand how people think about and act on the natural environment have been minimal, yet most controversies and shortages are the result of human activity. Continued human population growth and increases in production, use, and disposal of resources are not matched by corresponding growth in the land base available to meet those demands under traditional resource management approaches while sustaining desired levels of environmental quality. Cooperative efforts between natural and social scientists are few. We have an excellent opportunity to increase our knowledge and solve problems if we accelerate research on human-natural resource interactions and if we better understand the social ecology of these resources.

In the past, it was often possible to devise purely physical and biological solutions to many of the natural resource issues faced by land management agencies. Increasingly, however, the nature of these challenges in the United States is changing. Questions of conflicting values and interests, desired future conditions for the nation's public lands, and the social and economic tradeoffs of various land management options require a thorough understanding of the human dimensions of natural resource use. These include:

- **Behaviors.** Often, the most direct manifestation of the attitudes and beliefs held by the public is through their actions and behaviors.

The Ecosystem Approach: Issues

- **Cognitions.** Understanding how the public perceives and learns about natural resources is critical to developing future planning and management options.
- **Communication.** Many of the most difficult issues for agencies to deal with are those particularly related to communications with numerous diverse publics.
- **Trends.** It is crucial to the sound stewardship of the nation's resources that policy and decision makers understand the implications of societal change. However, we should not mislead the public into thinking that the ecosystem approach will allow optimal use of all resources. Some difficult tradeoffs will be necessary.

Ecological restoration technology development.

An effective ecosystem approach may restore impaired ecosystem functions (see Science Success Story 4), although restoration science is considered by many to be in its infancy because there has been a limited market for its use. This situation is likely to change. For example, effective riparian restoration technologies are needed to protect the anadromous fish-bearing waters of the Pacific Northwest, and Coastal Louisiana needs innovative wetland restoration techniques. Also, we need unique restoration technologies to address urban ecosystems such as the Anacostia River basin. Funding research programs in restoration technology and improving the economic arguments associated with restoration of specific ecological functions in high-priority ecosystems will help the growth of restoration businesses and increase the contributions they can make to the ecosystem approach. In many cases, restoration efforts have focused only on the restoration of structure and composition, merely inferring that essential ecosystem functions will follow. Seldom have restored systems been monitored to confirm that functions are back on line. This is the central logic used when allowing one wetland to be drained in return for flooding another. There may be no net loss of area, although there may be a significant loss of function.

Funding available for restoring ecosystems will be finite. Priority should be given to projects where ecosystem processes can become self-perpetuating after initial investments are made.

Quantifying uncertainty and assessing risk.

Science can make a major contribution to the ecosystem approach by explaining cause-and-effect relationships. In addition, scientific data can answer a management question and a measure of that answer's certainty. In communicating scientific data to nontechnical managers and the public, however, the measures of certainty are often lost or overlooked. Assessing the relative likelihood of an adverse ecological impact is another situation in which quantitative science sometimes falls short of a desirable level of certainty. In environmental crises, it is impractical to invest the time and funding to reduce uncertainty before taking immediate action on the basis of best professional judgement and limited data. The ecosystem approach usually involves timeframes that allow for midcourse correction, and actually should require increasing the known levels of scientific certainty underlying key management assumptions, actions, and strategies.

The costs of quantification and not recognizing these data as essential make handling uncertainty and risk in management more difficult. In overcoming these obstacles, we must emphasize the clear communication of the importance of quantifying the uncertainty underlying key scientific data, and placing high priority on supporting research that will reduce this uncertainty.

Modeling. In order to support prediction, planning, and decision making on an ecosystem basis, scientists and managers require models that are sensitive to how modifications to land or water affect habitat and ecosystem functions. These models must incorporate a much wider array of factors than are addressed in most current models. They must link landscape changes, changes in water use, observed changes in selected ecological indicators, multiple species responses, and changes in ecosystem condition and function. They must be field-tested to determine their "real-world" applicability.

The limitations of modeling to support the ecosystem approach are related to geographic scale; most ecological modeling has been very localized. Development of comprehensive models for several of the major ecosystems in the United States has been limited by funding as well as by inexperience in modeling on larger scales. Several actions, however, can enhance what modeling has to offer.

Science Success Story 4. *Restoration of a Mixed-Grass Prairie Community at Lostwood National Wildlife Refuge, North Dakota*

Objective: To restore and preserve indigenous biotic communities of circa 1870–1890 on a representative sample of the physiographic region known as the Missouri Coteau.

Background: The U.S. Fish and Wildlife Service's Lostwood National Wildlife Refuge was established in 1935 "as a refuge and breeding grounds for migratory birds and other wildlife" on 27,000 acres of grasslands interspersed with about 4,200 marshes, temporary sloughs, and lakes in northwestern North Dakota. Management of native mixed-grass prairie communities is difficult, because information on composition, interaction, and temporal dynamics of historic fauna and flora is scanty and diffuse. Exotic and alien species provide additional, almost overwhelming challenges. With a staff of only two, the Refuge's future depended on cooperative research efforts and monitoring assistance.

Collaborators: The Northern Prairie Science Center of the National Biological Service; Montana State University; North Dakota State University; the University of North Carolina; the University of Missouri; the University of Tübingen (Germany); the University of Wisconsin–Stevens Point; The Nature Conservancy; the North Dakota Department of Health; and Ducks Unlimited.

Benefits:

For managers:

- Vastly improved decision-making capability due to substantive support.
- Enhanced knowledge of area resources.

For researchers:

- Opportunity to contribute reliable knowledge.
- Generation and publication of data with inferential value.
- Contribution to successful completion of college degree programs.

For both:

- Successful cooperation benefitting resources of common concern.
- Opened lines of professional communication and expanded awareness.
- Shared expenditures.

Learning Points: In serving as a learning template and demonstration area for prairie resources managers and students of prairie ecology, the Lostwood National Wildlife Refuge has hosted studies that have helped improve and safeguard its native wildlife resources. In turn, the Refuge has been recognized as one of the most diverse and progressively managed areas in the northern Great Plains. Recognition has led to opportunities for further research and to outside assistance to meet pressing management needs. Closer adherence to principles of adaptive management should further improve research and monitoring on the Refuge.

Detailed models dealing with ecological processes and with variations in species populations over very small areas should be linked and extended to watershed/landscape and regional scales. Simulation models should be developed to predict future ecosystem function and productivity caused by changes in land and water use or in management approach. There should be particular emphasis on the development of "warning systems": models that indicate when thresholds of ecosystem degradation are being approached, help predict potential improvements, measure progress, and assist managers in identifying appropriate responses. Another important role for models is on the front end of option development where they can be used to determine knowledge gaps, research needs, and the relative importance of various factors in an ecosystem. Many agencies need improved computing capability to support complex and data-intensive landscape change simulation models, as

well as larger and more complex ecosystems models.

Adaptive management process. Adaptive management is essential because our understanding of ecosystems is not, and may never be, complete. Because the ecosystem approach must rely upon the best science available, there must be a way for managers to incorporate new knowledge as rapidly as it becomes available so they can modify their management approaches. Although it shows promise as an emerging concept, adaptive management still must become a clearly defined and broadly tested framework or family of processes. Without such a guideline, ecosystem managers may be prone to reactive, trial-and-error learning instead of proactive planning for continual incorporation of better scientific knowledge. Trial and error may have to be accepted for a while until ecosystem functions and responses are better

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known. Precisely because of this, adequate monitoring programs are needed to gain as much knowledge as quickly as possible.

There may be several barriers to developing this framework. There is no current governmentwide or cross-organizational structure under which to assemble a working group to tackle this task. Reconciling the different perspectives of contributing scientists will be a challenge, especially if the development process is not given sufficient time to mature and gain acceptance. Nevertheless, if the goal of such an effort is to develop a broadly applicable and flexible framework for action, a consensus product may be possible. The key elements of the framework should include: establishing goals; planning for unanticipated outcomes; recognizing appropriate time frames for resource management, recovery and sustainability; systematically reducing uncertainty in critical areas; the roles of assessment, modeling, and monitoring; general procedures for reconciling conflict; and general procedures for modifying policies and management approaches using new scientific data.

Fragmentation of Scientific Efforts

Regional or ecosystem information is often unavailable because there is no mechanism for identifying, locating, or assessing it, or of determining its nature and quality. Because of the lack of institutions and mechanisms for collaboration, the development of regional or ecosystem perspectives that have multiple issues and factors remains difficult and is often simply not attempted. For example, data bases that might, if integrated, show patterns among or between stressors and biological effects, or between population trends among different species, remain uncomparing or incomparable.

It should be emphasized that in most cases, development of regional or ecosystem data systems does not imply development of major, centralized data bases or facilities. Current technology can easily support a fully distributed data management strategy, in which individual entities are responsible for collecting, updating, maintaining, and making data available to others through sharing and electronic transfer.

Developing regional geographic information systems may involve bringing data from many sources into a central location or system. However, the

concept of distributed stewardship still applies, since periodic information updates are still performed best by agencies with specific mandates, expertise, or resources. It should be stressed that what we need is information management and that data management is a necessary component. Most managers will not use data, but are desperate for information that can be or is integrated.

Barriers to development of regional ecosystem information include the following:

- Agencies, institutions, and individual researchers have focused more often on acquiring specific information and developing data systems for it than on integrating their information with that collected or managed by others. Few agencies define their mission to include regional data networking. Interagency rivalry and concerns over cost recovery have frustrated efforts to develop regional data or geographic information systems.
- Software and hardware acquisition is rarely if ever coordinated, even among units within a single agency.
- Until recently, access to communications software and hardware, including Internet, was the exception rather than the rule among many agencies and institutions.
- Although agencies frequently are willing to commit to the initial collection of regional-scale data, long-term commitment to maintaining and updating such data is rare.

Overlapping Efforts

Often, there are several agencies and institutions undertaking scientific activities within a region, yet there is often no forum for sharing plans or results, or for comparing, synthesizing, or integrating available information. It is crucial to use mechanisms such as the electronic forum recommended here and to rely upon regional fora as fully as possible. Such mechanisms can be used to identify new scientific priorities, but also to target areas of lower priority so resources can be re-directed to more important questions. Barriers to coordination of regional efforts include the following:

- Individual agencies develop scientific agendas that address their specific mandates and responsibilities.
- There is often greater emphasis on working within an agency or within a specific issue area than there is on addressing broad regional issues. Unless there is a strong public/political consensus about the urgency of addressing regional needs, such interactions are implicitly or explicitly discouraged.
- Individuals and agencies are not rewarded for cooperation and coordination.
- The Federal Advisory Committee Act, which requires groups that provide advice or recommendations to federal agencies to be formally chartered, limits participation to named members; imposes cumbersome administrative requirements; and makes it difficult to establish bodies that include scientists from federal, state, local, and private sectors that are meant as links among regional scientists, and between scientists and decision makers. Some state "sunshine" laws (in Florida, for example) also provide similar disincentives.

Narrow Focus

Scientists often focus on relatively narrow disciplines or issues, with few opportunities, incentives, or mechanisms for working on broader scale interdisciplinary or multidisciplinary issues. Science agencies must be prepared to share information about their allocation of resources, and management agencies must be prepared to identify higher and lower priority information needs.

The narrow focus of scientific disciplines and education is a barrier to interdisciplinary approaches. Addressing complex, broad issues requires interactions with more scientists and from different scientific cultures, working at different geographic or time scales, and focusing on different aspects of an issue. Opportunities to be published are greater within a discipline than across disciplines.

Lack of Standardization

There is a lack of standard terms and procedures for conducting research and monitoring. As a

result, there have been few attempts to synthesize and integrate currently available information. Barriers to standardization include the following:

- Information has often been collected with varying standards, methods, and quality control, making integration difficult.
- Agencies and even different management units within the same agency have used different terminology for a variety of ecological features including ecological classifications and definitions for common terms such as "forest." Data acquisition and comparison is thus uncoordinated.

Insufficient Translation of Results

There is insufficient translation of scientific findings into products that are usable by managers or language that is understandable by managers and the public. Barriers to translation of results include the following:

- The narrowness of scientific disciplinary inquiry makes it difficult for either scientists or managers to relate them to larger issues.
- Scientists and managers use different "languages."
- Public officials, the public, and scientists have different perspectives on certainty and risk. Public officials often must, or feel they must, act based on the best information at hand. Scientists, on the other hand, focus on the inadequacies in knowledge and urge "further study" before any action is taken, but decisions and tradeoffs can't always wait. Yet, public officials and members of the public want solutions that can be guaranteed. Scientists must get involved in the process to help ensure the best decision based on currently available information.
- There is a lack of peer support and incentives for publishing for public consumption. Scientific culture and the systems used in government reward scientists for publishing new findings. With only slight exaggeration and few exceptions, activities that do not lead to publication in peer-reviewed literature are accorded very low value by

either of these systems. Activities that translate scientific findings to make them understandable to managers or the public, or development of systems for dissemination of information are rewarded insufficiently.

- Managers are, for the most part, not involved in designing or setting objectives for scientific studies.

Issues Relating to Scientific Focus

In the current mix of federal scientific efforts, long-term monitoring, observation, and evaluation are underrepresented. Moreover, research managers often lack the ability to respond to new issues or increase the emphasis on new disciplines.

Long-term monitoring. Federal, state, private, and academic institutions undervalue long-term monitoring, observation, and evaluation; there are few incentives and little peer support for this work. Monitoring efforts come and go as often as new issues arise. When new efforts are developed, they involve different sites, different parameters, and different sampling designs without regard for long-term continuity or comparability.

In part, this results from the fact that past efforts were often not designed with statistical rigor, and were focused on narrow issues. In part, it may result from the fact that design, development, and implementation of monitoring systems is not, in itself, valued by scientific culture or government reward systems as highly as analyses of results from such systems. Thus, their long-term "care and feeding" is neglected.

Response to new issues. When new issues arise, the mix of scientific disciplines in the current workforce may not be appropriate to address them. The personnel structure of much of the federal science establishment makes it difficult to shift disciplines as these new issues arise. Federal scientists are generally career employees. Addressing a specific issue in a specific region involves hiring scientists of specific disciplines. Changing circumstances may demand different disciplines, or a different regional allocation of resources. This is particularly difficult when such changes involve relocation of staff or reductions in force.

Information Management Issues

The speed, capacity, and complexity of information systems have improved at an unprecedented rate during the past decade. Although these advances have made possible more sophisticated and efficient information storage, retrieval, analysis, and integration, information management is not without issues and barriers. The following are some of the recurrent information management issues encountered in survey team interviews.

Information systems hardware and software. In the past few years, rapid advances in information science and systems have considerably improved the capability for supporting a large-scale ecosystem approach. These improvements will continue as technology advances. Two general shortcomings, however, still affect the ecosystem approach. First, data consistency and comprehensive coverage are more limiting than information systems capability; it is frequently necessary to fill gaps in data production to adequately characterize an ecosystem. For example, although geographic information systems have a well-demonstrated potential as an environmental and socioeconomic analysis and data base management tool, many of the fundamental data layers necessary for a national spatial data infrastructure still need some work to be completed. Second, scientific information systems are by and large still the realm of computer specialists and present barriers the public and to noncomputer-oriented managers and decision makers. Translating scientific data for broader understanding is only a partial solution that must be augmented by user-friendly access to some ecosystem data bases.

Syntheses of the state of knowledge. Despite the proliferation of scientific studies and data bases in numerous locations and organizations, comprehensive information syntheses for an ecosystem of interest are relatively uncommon. In these situations, the "weight of evidence" remains uncertain and scientists may duplicate efforts, miss opportunities to use relevant data, and perpetuate uncertainty or controversy. A comprehensive approach to the ecosystem approach is often hampered by the logistical difficulties of seeking data from far-flung sources, then attempting to create a clear picture from these sources. To some extent, this is

a necessary evil in order to involve the all parties that can contribute to an ecosystem's science base and management. However, it can be balanced successfully through a planned, major synthesis of the most important information instead of reactive attempts to compile relevant information from event to event. The Alton Jones Foundation assessment of Coastal Louisiana, for example, was an independent activity that concentrated on a comprehensive review and synthesis of the state of existing science; as a result, the assessment has improved insight into controversial areas before the weight of evidence was compiled and synthesized.

RECOMMENDATIONS

The need for scientific information as a foundation for resource management decisions continues to increase dramatically. Changing public expectations and increased public involvement have challenged traditional management policies and practices. Often these public expectations are in conflict. The interface between social, economic, physical-biological, and ecological models must be improved. The ability to quantify social demands for both consumptive and nonconsumptive goods must be perfected. These demands must then be weighed against the need to maintain ecosystems and their attributes. We need innovative ecosystem approaches and technologies that will accommodate these demands while maintaining healthy ecosystem functioning.

There is a pressing need to assemble and format new and existing research results into packages that are usable by managers and decision makers. Efforts to synthesize science, identify information voids, and set priorities should be increased. Long-term observations of biological systems are invaluable in providing information on their responses to human-induced and natural changes and in providing necessary understanding for predicting the future of these systems. Research on computer-based decision support models and expert systems shows that there can be an effective interface between management and research. We must be able to reasonably predict the future condition of resources resulting from management options. A comprehensive program (see box 3) of integrated basic and applied

ecological, social, and economic research would provide:

- More adaptive and flexible management systems.
- An improved information base for decision making.
- Techniques for incorporating spatial analysis to link objectives at differing scales into planning and decision making.
- Methodologies to predict responses of ecosystems to management activities.
- A basis for sustaining ecosystem productivity and biodiversity.
- Methodologies for integrated planning and management across site, landscape, and regional levels.

The lessons learned through this study are that, whereas it may be important to identify key scientific gaps, the barriers and their solutions may be more social or institutional than scientific in nature. We have the following recommendations:

1. Due to its key role in the implementation of the ecosystem approach, establish science as one of the bases for making decisions by using decision support systems that allow weighing of alternative solutions.
2. Use adaptive management as the model for implementation of management activities.
3. Implement and require monitoring and the evaluation of its results as part of adaptive management. Greater demand for this product will enhance its standing within an organization.
4. Develop a research and development strategy and implementation plan for the ecosystem approach. This could be done, for example, as part of the National Science and Technology Council/Committee on the Environment and Natural Resources process.

Box 3. Potential Framework for Developing a Comprehensive Ecosystem Research and Development Agenda for the Ecosystem Approach*

Technical assistance and training to managers and decisionmakers, including:

- Designing analysis processes, including watershed analysis, to custom build management and protection plans.
- Interpreting standards and guides, or other direction selected for implementation, and scientifically assessing proposed actions.
- Developing multiagency management, planning, and information systems.
- Developing innovative alternatives to traditional resource management activities on adaptive management areas.
- Synthesizing/assessing all relevant available scientific information.

Technology development and testing, including:

- Producing research and development plans that address longer term support needs and fill critical information gaps.
- Developing more appropriate and effective mechanisms for the public to become directly involved in resource planning, management, and regulation.
- Expanding values and benefits to society within existing legal, economic, social, and biological limits.
- Developing procedures for conducting watershed analyses that evaluate geomorphic and ecologic processes in specific watersheds.
- Developing models for predicting outcomes.
- Developing the adaptive management process.
- Developing information systems, data bases, and tools for regional-level analysis.

Filling gaps in our understanding with research on:

- Ecology on multiple scales (including ecosystem processes and functions).
- Multiple-species science (including species viability assessments).
- Monitoring and evaluation.
- Measures and indicators of success (including indices of resource conditions).
- Techniques for restoring of damaged ecosystems and components.
- Quantifying uncertainty/risk.
- Habitats of special interest, such as riparian corridors and aquatic ecosystems.

Developing incentives and mechanisms for coordination and cooperation:

- Between agencies that are developing and conducting research programs.
- In conducting interdisciplinary research.
- In organizing regional scientific forums and other processes for establishing consensus research priorities.
- In writing for the public.
- In technology transfer.

*We have adapted the framework developed in the Pacific Northwest to reflect the needs identified in all the case studies.

5. Give priority to research that is critical to the ecosystem approach, first for socioeconomic science, human dimensions of natural resource use, ecorestoration techniques, adaptive management process, information management systems, and syntheses of the state of current knowledge. Next, research emphasis should be increased on ecology on multiple scales, multiple species science, monitoring and evaluation, benchmarks and indicators, quantifying uncertainty/risk, and modeling.

6. Direct funding to overview and translation activities. For example, participants in the Anacostia effort mentioned their inability to obtain comprehensive syntheses of information on restoration techniques. An up-to-date synthesis and reference guide on this subject is necessary and may require electronic "publication" and maintenance. Expertise directories are needed also.

7. Identify regional research priorities and ways to address them cooperatively. It is

critical to organize regional scientific forums. Scientists must communicate not only within their own discipline, such as through disciplinary societies, but must help develop multifaceted regional understanding, models, and data bases. Create formal regional forums via the Internet (which complement the above fora) on which study plans and preliminary results can be posted. This will allow greater input (in effect, providing enhanced preproject peer review), encourage greater sharing of results, and reduce duplication of efforts. These forums can also be the place for discussions that involve several disciplines, including both natural and social scientists, on the development of appropriate "indicators." This term has many meanings, but generally refers to a parameter that can be measured reliably and that has some known relationship to overall ecosystem function. Indicators determine whether a system is moving toward or away from a desired state. Scientists of different perspectives and disciplines must agree about the validity, accuracy, or interpretation of these indicators if they are to be adopted by decision makers and relied upon by the public. Link regional science forums to regional management decisions. An excellent example is the South Florida model, in which there are separate but linked, regional interagency groups: one involves scientists, the other managers. In this case, to the involvement of nonfederal scientists is restrained and must be made easier, but this type of science-management link should be replicated elsewhere. Universities can be involved in implementing interdisciplinary science in management decisions.

8. Expand, support, and build upon ongoing regional and national assessments of the state of knowledge for individual species and groups, habitat types, and ecosystems.
9. Establish regional data systems to coordinate data collection efforts, acquisition of data management systems, and development of data bases in order to make information more accessible.

10. Support regional data coordination efforts by multiple agencies (in addition to their local and state support) if no single agency has the mandate or resources to support development of data catalogs, or agreements on key regional information needs, or the detailed and time-consuming work of determining transfer protocols, data sharing arrangements, and similar efforts that are necessary for successful regional data networks. (Examples include the Interagency Resource Information Coordinating Council in the Pacific Northwest, the Great Lakes Information Network, and National Biological Service funding of a data coordination position in the Southern Appalachian Man and the Biosphere Reserve program.)
11. Develop common standards, definitions, and protocols for research and monitoring terms and procedures along the lines of work being done by the Federal Geographic Data Committee and National Biological Service.
12. Hold workshops for regional data base development activities that will develop a consensus for a national interagency approach while accommodating regional differences.
13. Encourage and strongly reward interdisciplinary science.
14. Develop performance appraisals and evaluation procedures for federal scientists that reflect the importance of technology transfer and long-term monitoring as fundamental components of research positions.
15. Develop more flexible agency approaches to managing and conducting science by using more personnel exchanges (under the Intergovernmental Personnel Act), fellowships, and extramural researchers. Careful analysis should determine which agency/scientific functions are more amenable to flexible versus permanent arrangements.

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16. Recognize the value of releasing a useful, sound monitoring data base by including it as a form of publication in scientist evaluations.
17. Encourage scientists to apply a "so what" standard to basic science and theory: how can this information be used to refine or improve management activities? Although every research project will not be directly relevant to management, it is important that overall scientific programs be connected to real-world problems.
18. Expand communication in science and management agencies to include not only identification of problems to be solved (generally undertaken in the context of developing budgets), but also site selection (to facilitate early application of information to decisions as well as incorporation into research publications), objectives, and the like. These contacts should be regular, not just at budget formulation time.
19. Establish the position/function of information specialist or scientific translator and recognize the function as important. The function must provide a key bridge between scientists, managers, and the public. Persons in such positions must understand and translate scientific findings, and understand management needs and programs in order to articulate the scientific needs of those programs.*

*There is some disagreement with this idea, since it could result in a greater gulf between scientists and the users of science.

Chapter 6: LEGAL AUTHORITIES

This chapter serves four purposes: (1) to identify major legal authorities that are directly relevant to federal agencies' implementation of the ecosystem approach; (2) to encourage agencies to devise creative ways (either under existing authority or requiring new legislation) to implement the ecosystem approach; (3) to identify for policymakers federal barriers to the ecosystem approach (including gaps in authorities); and (4) to make both general and specific recommendations about how agencies can utilize their legal authorities, seek further authorities, or improve upon current tools to practice the ecosystem approach.

Following an Introduction and Summary, this chapter discusses the twin goals of the ecosystem approach—maintaining ecosystem health and promoting sustainable economies and communities. In the following sections, legal authorities are explored in relation to important elements of the ecosystem approach: working and coordinating on an ecosystem scale; developing partnerships with private landowners; communicating and working with stakeholders; coordinating with other governments; and using adaptive management. Recommendations are interspersed throughout the chapter and summarized in the final section.

INTRODUCTION AND SUMMARY

The federal government currently has significant statutory authority available to take an ecosystem approach to federal activities and to pursue collaborative efforts with state, tribal, and local governments and private parties. No single federal statute contains an explicit, overarching national mandate to take an ecosystem approach to management, and Congress has never declared that a particular federal agency has the ecosystem approach as its sole, or even primary, mission. Each agency operates pursuant to specific mandates that govern the particular lands that the agency manages, the environmental media (such as air and water) that it regulates, or the development projects that it builds or finances. However, many federal statutes provide agencies with opportunities to take an ecosystem approach, and a surprising number have been drafted with whole ecosystems in mind.

Because the ecosystem approach is an emerging paradigm, and because agencies are still experimenting with translating the paradigm into management policy, the statutory limits on the ecosystem approach are not yet entirely clear. At this point, progress towards greater use of the ecosystem approach depends more on continuing institutional, regulatory, and policy changes than on statutory change. Although federal law contains some impediments to holistic management efforts on larger scales, none impose an insurmountable barrier to incorporation of ecosystem approaches as agencies exercise their discretion within the law. This discretion, and the management tools that government agencies have developed over the years, give agencies the room to act creatively to promote ecosystem and community sustainability.

The legal authorities issues group reviewed federal legal authorities with two basic questions in mind. The first was: Does federal law, as a substantive matter, provide the opportunity to maintain healthy ecosystems and to promote sustainable economies and communities, the two fundamental goals of the ecosystem approach? The second question was: Does federal law provide the agencies that administer it the wherewithal to work effectively at local and regional ecosystem scales—to operate based on ecological principles, to coordinate with each other across broad landscapes, to facilitate input from various stakeholders and the public, and to engage in adaptive management?

Substantive Goals of the Ecosystem Approach

The ecosystem approach is possible where there are basic statutory authorities to protect ecosystems—namely the authorities to protect the environment, and the authorities to ensure sustainable economies.

Maintaining healthy ecosystems. The federal statutory structure contains a number of laws whose purpose is to protect the environment and public health. The body of pollution control laws that has developed over the last 25 years demonstrates a desire on the part of Congress and the public to protect the nation's air, water, and land,

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and, in many cases, associated ecosystems. Other laws, such as the National Environmental Policy Act (NEPA), Endangered Species Act, and federal land management laws, show congressional intent to conserve additional natural resources, and to seek a balance between conservation and sustainable management and use of natural resources. NEPA, for example, requires that federal agencies analyze the effects of their significant activities on the components, structures, and functioning of affected ecosystems.

Congress has sometimes chosen specific types of ecosystems or even specific places as the focus of legislation. This can work extremely well to encourage regional and local cooperative efforts. Coastal and estuarine ecosystems, because of their fragility, importance for commercial fishing, and environmental significance, are often the subject of this type of legislation. Laws such as the Coastal Zone Management Act and the Clean Water Act's National Estuary Program are effective because they establish a requirement for coordinated planning on an ecosystem basis and a structure for doing so. As a result, they support, encourage, and help direct state and/or local planning efforts.

Laws like the state and federal New Jersey Pinelands statutes are effective for similar reasons. The statutes governing the Pinelands require rational, sensitive development in accordance with a comprehensive plan. As a result, key natural resources are preserved at the same time that sensible economic development can go forward. Other discrete ecosystems such as coastal Louisiana and the Florida Keys have also been the subject of congressional efforts. There may be other priority areas in the nation for which this type of state and/or federal legislation would be beneficial.

Where federal land is not designated for a specific purpose, use of lands can promote sustainable economies by allowing multiple uses, such as range, mining, timber and fisheries management, tourism, recreation, sport hunting and fishing, military activities, and scientific study. Most multiple-use statutes vest the agencies with wide discretion to provide the best mix of uses. These statutes have not always been administered to ensure that the uses of the land are integrated with the need to maintain healthy, productive ecosystems, and have

been criticized for reducing long-term community, economic, and resource sustainability.

Some federal laws promote environmentally unsound practices. For example, the Mining Law of 1872 promotes mineral extraction over other uses, generates little return on important public assets, and has necessitated public expenditure for such impacts as acid mine drainage reclamation. Other laws provide federal subsidies for agricultural practices that have a detrimental effect on the environment, and for benefits like flood insurance that encourage development in fragile areas. In the absence of statutory change, these impacts can best be addressed through coordination of existing ecosystem protection authorities and public education.

Sustainable economies. Federal laws, including environmental laws, promote this second goal of the ecosystem approach by discouraging some activities that damage ecosystems and by providing opportunities to promote economic development and community stability. In general, natural resource management in the United States, even management whose purpose is environmental protection, is not undertaken in disregard of economic consequences. The National Environmental Policy Act (NEPA) requirement that agencies analyze the social and economic consequences of environmental impacts is one example. The NEPA analysis for the recent Pacific Northwest Forest Plan, for instance, was used not only to ensure protection of forest ecosystems, but to guide job relocation programs. An analysis of economic trends provided information on viable local industries and helped direct federal resources towards assisting the region in making the transition to a more sustainable economy. Federal environmental reviews would benefit from greater use of such socioeconomic analysis.

Many federal laws that are directed to natural resource management expressly take into account economic factors. One of the primary purposes of a number of U.S. Department of Agriculture and Department of the Interior authorities is to provide for sustainable use of federal resources, with an emphasis on assistance to local economies. Some laws, such as the Oregon and California Railroad and Coos Bay Wagon Road Grant Lands Act, can be read to give priority to economic development, although they have not been found to override

modern environmental statutes. Of course, prudent management must respect the limits to which resources can be exploited and the effect on ecosystem sustainability.

This chapter does not analyze the array of statutes, other than primarily natural resource or environmental statutes, that can contribute to sustainable economies. An analysis of the economic development statutes (for example, Community Development Block Grants) and the role they should play in increased use of the ecosystem approach would be useful. To be effective, an ecosystem effort must be based on an understanding of local economies and communities, and must provide for economic development that maintains functioning ecosystems over time.

In sum, federal law, sometimes acting in conjunction with state law, provides a range of authorities (and mandates) for considering or protecting ecosystems, and for encouraging sustainable economies and communities. What is required is a *balance* between the two—a challenging and complex goal, especially in a world where ecosystems and economies are constantly changing. To achieve this balance, agencies must have available under existing law a diverse array of practical tools.

Tools for the Ecosystem Approach

The ecosystem approach requires agencies to do several things: to coordinate planning and management where appropriate, even where agencies operate under different mandates; to plan and manage on an ecosystem scale—that is, with ecological, not just administrative, boundaries in mind; to protect the rights of private landowners; to ensure early and active stakeholder participation; and to use adaptive management—to adjust their activities as applicable scientific principles evolve and as new information becomes available. Again, although federal laws were generally not written with the ecosystem approach in mind, creative use of them can take agencies a long way towards wider implementation of the ecosystem approach.

Working and coordinating on an ecosystem scale. From a federal standpoint, one of the biggest challenges of the ecosystem approach stems from the recognition that ecological boundaries and the interconnections within them are critical to management, and that agencies must

therefore seek to better coordinate their activities based on ecological boundaries. Although the ecosystem approach is a relatively new framework for federal agencies, there are numerous useful models for coordinating on an ecosystem scale already expressed in, or authorized by, federal law.

Interagency coordination. Federal law mandates or provides a framework for interagency coordination in a variety of contexts, including generally applicable statutes like the National Environmental Policy Act (NEPA), statutes specifically directed at particular ecosystems or types of ecosystems, and regulations that establish coordination structures in contexts not directly related to the ecosystem approach.

National Environmental Policy Act. NEPA provides a ready-made framework, as well as a mandate, for interagency coordination regarding proposals that may significantly affect the environment. As part of its direction to agencies to consider the ecological impacts of their activities, NEPA requires agencies to consult with other agencies and to take their views into account in several ways. It mandates consultation, at various stages of developing an environmental impact statement (EIS), with any federal agency that has jurisdiction or special expertise with respect to any environmental impact involved, and it provides that “affected” federal and nonfederal agencies must be notified of the proposed action and afforded an opportunity to comment on the proposal. An EIS must address possible conflicts between the proposed action and the objectives of, among other things, state and local land use plans and policies in the area at issue.

In addition, the NEPA process could be used more proactively as a framework for the ecosystem approach through regional interagency ecosystem-based EISs. Benefits from this approach would include: tailoring the analysis, including cumulative effects analysis, to a regional or local ecosystem scale; improving interagency coordination, including information and resource sharing, and collaboration with state, tribal, and local governments; improving public participation in decision making; and establishing coordinated monitoring and adaptive management approaches, where appropriate. A federal court recently upheld the federal government’s authority to do this type of planning in the context of the President’s Pacific Northwest Forest Plan.

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Federal land management statutes. Federal land management statutes such as the National Forest Management Act and Federal Land Policy and Management Act authorize, and often require, coordination of planning and management initiatives with other federal agencies and nonfederal governments. The provisions can be read to authorize or direct coordinated land management at regional or local ecosystem scales, as appropriate and consistent with other agency mandates.

Other frameworks and models. In some cases, Congress has expressed a legislative desire for interagency coordination where specific ecosystems are involved. For example, the Clean Water Act's National Estuary Program requires, for certain designated estuaries, the convening of a management conference, which includes all interested federal agencies, as well as other governmental and private parties. The federal Coastal Wetland Planning, Protection, and Restoration Act, which governs the restoration of wetlands in Louisiana, requires five federal agencies (along with the state of Louisiana) to coordinate their approaches to wetlands restoration.

Other laws or mechanisms provide potential models for coordination among federal, state, and local officials. For example:

- The Clean Water Act and Comprehensive Environmental Response, Compensation, and Liabilities Act mandate the development of the National Oil and Hazardous Substances Contingency Plan (NCP) to provide the national and regional organizational structure and procedures for preparing for and responding to discharges of oil and other pollutants. The NCP delineates responsibilities among federal, state, and local officials. Similarly, federal agencies that are natural resource trustees are developing structures for coordinating on natural resource damage restorations in particular ecosystems.
- Under the Endangered Species Act, experience has shown that the Habitat Conservation Planning process allows private and government scientists to cooperate to gather necessary scientific data and follow a multi-species, ecosystem approach to conservation. Regional Habitat Conservation Plans are promising mechanisms for bringing

together stakeholders to plan and craft innovative solutions at a regional level.

- Relying on general or specific statutory authority, agencies are making increasing use of Memoranda of Understanding (MOUs) to ensure coordination on issues of interest to all. Some are directly associated with statutes, such as a recent MOU that a number of agencies signed to ensure better coordination on a regional basis of activities under the Endangered Species Act. Others are directed at selected geographical areas, such as the federal interagency MOU that governs federal efforts to restore the South Florida ecosystem, or the MOU that is being used to coordinate implementation of the Forest Plan for the Pacific Northwest. In the Pacific Northwest, in addition to a federal interagency policy task force, interagency teams were established in each of the eleven ecological provinces within the forest region to implement the President's ecosystem-based Forest Plan. The MOU model affords maximum flexibility and is therefore workable in a variety of contexts.
- A less formal model for federal, state, and local coordination is found in the Southern Appalachian Man and the Biosphere Cooperative and associated ecosystem management efforts. Participation in this group helps federal agencies to comply with coordination requirements and to evaluate ecosystem impacts that are beyond the capacity of any one agency to address.

Each of these examples of interagency coordination, whether explicitly or implicitly mandated by Congress, can be considered a model for future ecosystem efforts. Agencies can learn from past or existing coordination structures or relationships, and transfer them to new situations where agencies must work together. In general, improved interagency coordination depends much less on new legislation than on creative and concerted efforts by agencies to take a broader view that considers a balance among their respective missions.

Budget issues. Probably the most significant legal barrier to effective interagency planning and implementation on an ecosystem scale is in the budget structure. As discussed in the chapter on

Budgeting for the Ecosystem Approach, agencies that need to work together are faced with the following difficulties: authorizations and appropriations from different congressional committees; congressional funding commitments that are usually short-term or decreasing; and, in some instances, agencies statutory prohibitions from spending appropriated funds outside of their geographical jurisdiction, or from transferring funds to other agencies.

Planning. Especially where large amounts of federal land are at issue, the question is often raised whether different agencies' planning processes or regulations make it difficult to coordinate. In addition to budget problems, inefficiencies result from the fact that some agencies' planning processes are slow, and can impair other agencies' ability to do their own planning. For example, the U.S. Army Corps of Engineers (Corps) civil works program, which requires a lengthy and complex process whenever the Corps considers a water resources development or restoration project, has been criticized as rigid and time consuming. Among other things, the Corps must return to Congress for new authorizations when there are significant changes in a project. Other agencies involved in Corps projects must adjust their own planning to the Corps' timetable and funding restrictions.

Mission agencies. It is important to note that the "mission agencies"—such as the Departments of Transportation and Defense (including the Corps)—can play an important role in protecting ecosystems, and their ability to coordinate with other agencies, whose mission is more directly related to environmental protection, is paramount. For example, many Department of Defense installations, under the authority of the Sikes Act, have entered into cooperative agreements with the Department of the Interior and host states regarding conservation of fish and wildlife. NEPA provides mission agencies, such as the Corps and Department of Transportation, with a structure for coordinating and cooperating with other agencies on the environmental effects of their projects.

Information sharing. Finally, as noted in the chapter on Institutional Approaches, the ecosystem approach by federal agencies cannot succeed without the agencies' commitment to share their knowledge and expertise with each other. An

enormous amount of specific, targeted knowledge exists within each agency, but truly integrated management requires all those involved to have a better understanding of the full range of attributes of, and effects on, an ecosystem. Although there is some express statutory authority for interagency technical assistance (such as EPA's mandate to provide NEPA assistance or the Corps' authority to provide technical assistance), this work has been undervalued. The main barriers to increased information sharing appear to be funding and agency "turf" issues. There is a critical need for an interagency data base of ecosystem information to facilitate agency compliance with information requirements, such as cumulative effects analysis under NEPA, and to ease compliance with agency coordination requirements.

Ecosystem scale. Although planning on an ecosystem scale is relatively new, agencies already have a range of authority and a variety of models to choose from. Just as it has issued express instructions to federal agencies to coordinate with one another, Congress has also instructed the federal government to manage, or to work with state or local governments in managing, designated areas on an ecosystem scale. The New Jersey Pinelands state and federal legislation is a successful example of this approach. And NEPA directs agencies to assess the ecological effects of their actions.

Representative examples of agency efforts to implement their authority using the ecosystem approach are:

- *Endangered Species Act implementation.* The Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) have adopted a formal policy that would incorporate ecosystem considerations into a variety of activities under the Endangered Species Act. For example, where appropriate, group listings are made on an ecosystem basis, and recovery plans are developed for entire ecosystems inhabited by multiple listed species, and consultation is carried out on an ecosystem basis. The FWS and NMFS continue to encourage greater use of the Act's habitat conservation planning provisions, which can involve state government and private landowner cooperation in protecting species on an ecosystem scale.

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- *Forest planning.* In the Pacific Northwest, the President's Forest Plan is designed to coordinate the management of several national forests and other federal lands, and thus to protect a whole ecosystem and the species that inhabit it. A federal court has upheld the government's authority to do this kind of planning pursuant to NEPA, the National Forest Management Act, and other authorities.
- *Watershed planning.* Using its authority under the Clean Water Act, the Environmental Protection Agency (EPA) has established the "Watershed Protection Approach" as the conceptual foundation for administering its water programs. Under this approach, EPA promotes efforts by stakeholders and the public to identify the primary threats to human and ecosystem health on a watershed basis, and designs comprehensive, cooperative approaches to address those threats.
- *Wetlands mitigation banking.* The Corps and EPA have developed this tool to compensate for unavoidable wetlands losses before they occur. Landowners can restore or create wetlands and use those "credits" to offset "debts" incurred at a development site. The advantage of this program from an ecosystem-protection standpoint is that it allows for the restoration or creation of the most ecologically valuable wetlands, where technically feasible, and ensures that there is no temporal loss of wetlands in a given ecosystem.
- *Protection of specific ecosystems.* A useful model for a solely federal coordination group is the South Florida Task Force, which was formalized in a Memorandum of Understanding, and includes key bureaus from the U.S. Department of the Interior and representatives from the Departments of Justice and Agriculture, EPA, National Oceanic and Atmospheric Administration, and Corps. This policy-level group is charged with several tasks: developing federal objectives for restoring the ecosystem as part of the Corps' Central and Southern Florida project; designing an ecosystem-based science program; supporting the development of multi-species recovery plans; and coordinating a variety of specific restoration projects. Its efforts are supported by a field-level working group that provides on-the-ground implementation assistance, project monitoring, and ongoing oversight.
- *Land acquisitions.* Several statutes authorize federal agencies to acquire or exchange land with other agencies or nonfederal parties. From an ecosystem standpoint, mutually agreed upon land acquisition can serve several strategic purposes, including buffering sensitive areas and connecting portions of ecosystems that were previously fragmented. In the Prince William Sound area, to restore habitat injured by the *Exxon Valdez* oil spill, federal agencies have used their land acquisition authorities to purchase land or conservation easements from willing sellers in a way that increases protection of whole ecosystems.
- *Place-based regulations.* In some cases, activities subject to federal regulation are local in origin, and application of a single set of regulations is neither efficient, responsive, nor economical. For example, unique issues arise regarding the control and management of vessel traffic in different parts of the country. In response, the Coast Guard has developed field regulations for each area; the result has been an improvement in safety and efficiency.

These varied tools demonstrate that there is room in existing law for agencies to creatively exercise their authorities on an ecosystem scale. There is considerable opportunity for agencies to borrow these concepts from other agencies, or to expand them to different programs. Perhaps NEPA provides the best framework for an ecosystem approach. The procedures developed under NEPA could be used more frequently for programmatic environmental impact statements or other strategic programmatic planning on a regional basis.

In this regard, some agencies have been criticized for disregarding the implications of their own actions for resources beyond their jurisdiction. The ecosystem approach recognizes that land and resource management decisions affect, and are affected by, activities in surrounding areas. The recently proposed Forest Service National Forest Management Act regulation addresses this, recognizing that ecosystems often cross many

ownerships and jurisdictions. The principles of this new regulation also address the need to respect private property rights and coordinate planning with other agencies. Aside from budget constraints, there do not appear to be significant legal barriers to consideration by agencies of activities beyond their boundaries when they contemplate their own activities.

Other agency efforts, such as pollution control efforts, could be coordinated with overall ecosystem planning and coordinated more with state, local, and private planning efforts. Opportunities are many. The natural resource damage authority under several environmental statutes allows agencies to recover funds in enforcement actions and to use them to restore injured resources on an ecosystem basis. Supplemental Environmental Projects, which are environmentally beneficial projects undertaken by defendants in EPA administrative or civil enforcement actions in exchange for favorable penalty consideration in settlement, can be developed with ecosystem considerations in mind. EPA has already launched a project to use geographic targeting to focus pollution prevention and enforcement activities on the protection of sensitive ecological and recreation areas.

Coordination with nonfederal governments.

Because ecosystems transcend political boundaries in addition to interagency boundaries, collaboration between the federal government and state, tribal, and other national governments is critical to broader application of the ecosystem approach. Many of the statutory models for coordination described above provide for participation of states and tribal governments as well as more than one federal agency. A number of states, moreover, have already incorporated the ecosystem approach into administration of state programs. With respect to tribes, unique issues arise where off-reservation treaty-protected resources are located in ecosystems on state or federal lands. Finally, as discussed below, the Federal Advisory Committee Act (FACA) has presented some impediments to intergovernmental communications. A recently enacted exemption to FACA should help address these problems.

The ecosystem approach often has an important international component. The management of some ecosystems, such as the Great Lakes, inevitably raises international issues because the ecosystem itself spans international borders. Thus,

taking an ecosystem approach in border regions will typically require the cooperation of the neighboring nation. In addition, the health of an ecosystem that is defined as entirely within the one nation (such as the Chesapeake Bay) can be critical to the health of an ecosystem in another nation where species integral to both ecosystems migrate between the two. Similarly, ecosystem management efforts on U.S. territory may affect the environment of other nations or the global commons. The United States is party to a number of binding and nonbinding international instruments that address particular ecosystems, such as wetlands generally, or international boundary areas, or are generally pertinent to environmental issues.

Partnerships With Private Landowners

Taking an ecosystem approach requires that federal agencies pay close attention to the needs and views of private landowners and seek their voluntary participation in collaborative efforts. Federal activities must be predictable and their effects on private lands foreseeable, and federal regulations must be straightforward. Increased efforts should be made to administer federal laws and programs to facilitate these goals.

Existing programs include the P.L. 566 Watershed Program, which authorizes the Natural Resources Conservation Service to provide funding to local sponsors for watershed protection works such as riparian habitat restoration, land conservation, and flood prevention. Other programs provide incentives to restore wetlands, such as the Wetlands Reserve Program, which provides technical and financial assistance and an easement payment to landowners who restore wetlands. The Conservation Reserve Program provides similar benefits for fragile lands, particularly those that are highly erodible.

Other types of incentives, such as tax incentives to preserve land, exist but have not been extensively woven into federal activities and planning. Federal agencies should explore these arrangements. Finally, agencies can also assist private landowners indirectly, for example by reducing the burden on private landowners to conserve habitat. In the context of Endangered Species Act implementation, for example, the Departments of the Interior and Commerce recently announced policies to facilitate economic use of private land by placing additional federal lands in protection, acquiring

military lands when bases are closed, and arranging for purchases of Resolution Trust Corporation lands.

The ecosystem approach can also involve private landowners at its most fundamental level, where laws or agency policies allow for agreements between landowners and federal agencies in which landowners ensure that environmental goals are met in exchange for certain benefits. For example, the Corps' wetlands mitigation banking policy, described above, gives landowners greater flexibility in selecting development locations in exchange for a commitment to restore, create, or preserve valuable wetlands. The Endangered Species Act's Habitat Conservation Plan authority allows the Secretary of the Interior to enter into agreements with private landowners under which the Secretary permits "incidental takes" of listed species, and landowners agree to develop long-term, private conservation programs to protect listed species. In both of these programs, arrangements can be structured in a way that takes ecosystem considerations into account while meeting individual landowner objectives.

Finally, federal agencies are beginning to institute policies to assure private landowners that applicable federal requirements will retain a greater degree of predictability. Again, an example of recent progress is Endangered Species Act implementation. The Departments of the Interior and Commerce have policies that:

- Provide that landowners who obtain approval of Habitat Conservation Plans under the Endangered Species Act will not be subject to later demands for larger land or financial commitments, even if the needs of species have changed over time.
- Insulate landowners who voluntarily agree to enhance the habitat on their land from restrictions if they later bring their land back to its previous condition, or if the needs of particular species change over time.
- Establish that the Fish and Wildlife Service and National Marine Fisheries Service will identify, at the time a species is listed, specific activities that are and are not considered likely to result in a violation of the Endangered Species Act.

When landowners can better predict the consequences of future uses of their land, they can plan more effectively and with more certainty. This certainty plays an important role in ecosystem planning, which is most effective when participants have a high level of trust in each other and take a long-term view of the ecosystem, its desired condition, and socioeconomic issues.

Communicating and Working With Stakeholders

Since a cornerstone of the ecosystem approach is the active involvement of stakeholders, the ecosystem approach depends upon timely and widespread public participation. A number of federal statutes, including generally applicable statutes such as the National Environmental Policy Act (NEPA), and more specific statutes such as National Forest Management Act and the Federal Land Policy and Management Act, explicitly provide for public input into federal decision making that can take place at an ecosystem scale.

National Environmental Policy Act. The NEPA process encourages the involvement of interested and affected stakeholders. The NEPA notice and comment process as currently implemented, however, is often not conducive to the collaboration and consensus-building with stakeholders that is essential to a successful ecosystem approach. Beyond scoping and public comment, the ecosystem approach seeks to: bring stakeholders together to develop a shared vision for an ecosystem; recognize problems as shared problems; engage in joint data collection and analysis; and arrive at creative and innovative ways to maintain ecosystem sustainability and to achieve socioeconomic goals. One way the NEPA process could help achieve these ends would be through voluntary interagency regional ecosystem management environmental impact statements developed in close collaboration with nonfederal governments and the public. Similarly, Council on Environmental Quality guidance could be developed with a view to making the NEPA process more supportive of active and collaborative stakeholder involvement, both where agencies act individually and where they are planning together.

Other mechanisms. In the context of litigation and rulemaking, alternative dispute resolution mechanisms are becoming increasingly popular,

and lend themselves well to supporting cooperative ecosystem approaches. The Administrative Dispute Resolution Act authorizes alternative means of resolving disputes in court; another law encourages negotiated rulemakings to reach consensus and prevent litigation later on. These means of working out problems are often less expensive in the long run and more convenient for members of the public.

Congress or the executive branch has occasionally seen fit to establish dispute resolution schemes tailored to particular geographical regions. For example, the International Joint Commission was formed to assist the United States and Canada in protecting water quality in the Great Lakes basin. The United States and Mexico are parties to the International Boundary and Water Commission, which has served for many decades as a forum for resolution of water allocation and other binational resource issues. This type of dispute resolution body has the advantages of increasing the likelihood of focused participation and consensus among the members, especially if discussions are facilitated by a trained neutral, and of providing structured procedures for public involvement.

In addition, several statutes provide federal agencies with authority to create and fund educational programs. These can be used to educate stakeholders about the ecosystem approach generally or about particular issues. The National Environmental Education Act gives EPA general authority to fund educational projects on the environment, and specific statutes like the Clean Water Act provide EPA more limited educational grant authority. The Forest and Rangeland Renewable Resources Planning Act provides the Department of Agriculture specific authority to establish programs that expand public knowledge of the ecological relationships between forest resources and human communities.

Federal Advisory Committee Act. The law that has been most consistently cited as a barrier to the ecosystem approach is the Federal Advisory Committee Act (FACA), which imposes procedural requirements on federal agencies in certain circumstances when they solicit and receive collective advice from persons who are not full-time federal employees.

FACA was enacted to eliminate unnecessary advisory committees, limit the formation of new

committees to the minimum number necessary, keep the function of the committees advisory in nature, and hold the committees to uniform standards and procedures. The General Services Administration has published regulations establishing minimum requirements and providing guidance to agency management on the establishment, operation, and administration of advisory committees subject to FACA.

In addition, the Clinton administration has imposed stringent limitations on the creation and use of FACA advisory committees. Executive Order 12838 (February 10, 1993) directs each executive department and agency to terminate at least one-third of its advisory committees subject to FACA. The Executive Order also prohibits creation or sponsorship of new advisory committees subject to FACA except where (1) required by statute, or (2) the agency head finds that "compelling considerations necessitate creation" of the committee, and the Director of the Office of Management and Budget approves the advisory committee. The Administration has also announced a policy of opposing legislative language that "establishes new advisory committees or seeks to exempt groups from the requirements of the Federal Advisory Committee Act."

Because the ecosystem approach depends upon the input and participation of a wide range of individuals and interests other than the federal government, FACA issues often arise. The Act has presented particular problems with respect to state and tribal contacts. With varying success, several federal ecosystem management efforts have been challenged as violating FACA, including the President's Forest Plan for the Pacific Northwest, restoration efforts in South Florida, and federal efforts to protect salmon in the Pacific Northwest.

There are several ways to ensure that the provisions of FACA do not unduly hinder efforts to implement an ecosystem approach. First, section 204 of the Unfunded Mandates Reform Act of 1995 creates a FACA exemption for meetings between federal officials and state, local, and tribal officials for exchanging views, information, or advice related to shared responsibilities. Amendments like this one should relieve the burden of complying with FACA restrictions in the context of government-to-government collaborative activities. Second, the scope of FACA has sometimes been incorrectly construed by litigants or by agencies

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themselves. Agencies should train employees involved in ecosystem activities on sensitivity to FACA-related issues, and on the content and requirements of the Act, to make them aware of the situations under which contacts are appropriate, and methods for conducting contacts consistent with FACA.

Third, agencies should consider more extensive use of FACA-chartered advisory committees when seeking to collaborate closely with nonfederal stakeholders on a regular and systematic basis. Even though it is Administration policy to minimize the number of advisory committees, a chartered advisory committee may be the most effective way to obtain broad public participation in implementing the ecosystem approach.

Other barriers. Besides FACA, a concern commonly voiced during Task Force surveys was that, despite statutory administrative procedures to allow for public input into many federal and state environmental and land management decisions, agency officials often fail to establish the type of interactions with and among community members that leads to the consensus-building that is critical to the ecosystem approach. There is a tendency for officials to accept input, but not to encourage the constructive dialogue that can lead to collaborative solutions. Generally, beyond possible changes to the National Environmental Policy Act (NEPA) process, the answer to these problems lies in institutional, rather than legal, change. Guidance under NEPA, as well as expanded use of the Alternative Dispute Resolution Act, can help alleviate these shortcomings.

Monitoring and Adaptive Management

Adaptive management is a continuing process of planning, monitoring, researching, and adjusting to achieve management goals for an ecosystem. Good science and the flexibility to accommodate information about ecosystem and socioeconomic changes are both fundamental components of the ecosystem approach. But the need for systematically adapting agency practices in accordance with new scientific information has not traditionally been a major component of federal resource management, and applicable federal legal authorities have not been written with adaptive management in mind.

Once again, NEPA provides a good framework for addressing this component of the ecosystem approach. NEPA regulations provide significant opportunities for interagency cooperation, reduction of paperwork, and incorporation of the best existing environmental information into agency decisions. NEPA has proven to be an important starting point for adaptive management through its emphasis on monitoring and requirement for supplemental analysis when an agency finds significant new circumstances or information. It also allows agencies to make use of information collected by other agencies and under other statutes, such as water quality data gathered under the Clean Water Act. To the extent that a federal action may affect threatened or endangered species, the Endangered Species Act also supports the ecosystem approach with strong requirements regarding new information.

In this area, however, a number of barriers exist, some institutional. The NEPA process has not always effectively ensured that the environmental information gathered by agencies is verified over time or communicated to others in a form that is usable for future analyses. Moreover, NEPA does not mandate agency monitoring, although agencies must establish a monitoring program where applicable for any mitigation. Nevertheless, expanded interagency use of NEPA may form an appropriate basis for interagency agreements regarding monitoring and data base sharing to ensure that monitoring is carried out by federal agencies and nonfederal entities in an ecosystem or a region. To ensure that agency efforts are not wasted on environmental analysis that comes too early or late for a given decision, an interagency, programmatic NEPA approach can be used to prepare for site-specific proposals and new information, and to establish a system for interagency coordination.

Doorway to New Opportunities

Some commentators have advocated changing statutes to promote the ecosystem approach, including enacting laws that explicitly endorse the ecosystem approach (e.g., Keiter 1994). It is always helpful for agencies to have the benefit of express congressional authority to pursue what they believe is good government. But despite some specific impediments, the federal statutory scheme contains no overarching barrier to the ecosystem

approach, and in fact existing authorities provide agencies with broad flexibility to implement the ecosystem approach. The broad discretion that agencies enjoy should not be a barrier to the ecosystem approach, but rather a doorway to new opportunities.

AUTHORITY TO PURSUE GOALS OF THE ECOSYSTEM APPROACH

The substantive goals of the ecosystem approach are to maintain the health of ecosystems and to contribute to sustainable communities and economies. The executive branch currently has authority under federal law to make great strides towards achieving this goal. However, existing laws have not been consistently or fully administered to promote ecological and socioeconomic sustainability. Moreover, federal authorities at times operate at cross-purposes with efforts to achieve goals of the ecosystem approach.

Restoring and Maintaining Ecosystem Health

Congress has provided direction to the executive branch through numerous laws to protect ecosystems or their individual elements and processes. Although many of these laws are broadly framed in terms of protecting (or taking into consideration) "the environment" as a whole, Congress has also frequently recognized the importance of protecting the environment at an ecosystem level. Similarly, where Congress has granted them administrative flexibility, agencies have sometimes taken an ecosystem approach. Congressional direction to restore and maintain the health and diversity of ecosystems can be found in three types of federal statutes: (1) laws that apply to all ecosystems; (2) laws that govern management of federal lands; and (3) laws that specifically apply to congressionally designated ecosystems.

Laws that apply to all ecosystems. Several federal laws that apply to all ecosystems provide federal agencies with significant authority to maintain ecosystem integrity. Such statutes include the National Environmental Policy Act, Endangered Species Act, pollution control laws such as the Clean Water Act, and resource protections laws such as the Marine Mammal Protection Act. Many of these cross-jurisdictional statutes affect federal, state, local, and private lands; however, efforts could be made to ensure that they are

administered in a more coordinated, consistent manner to maintain healthy ecosystems.

Section 102(2)(C) of NEPA requires federal agencies to assess the environmental impacts of major federal actions. "Effects" are defined by the White House's Council on Environmental Quality in its regulations for implementing NEPA as including "ecological" impacts, "such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems" (40 CFR § 1508.8). NEPA thus requires agencies to consider the ecological impacts of their actions, and expands the factors that agencies are authorized to consider in taking action; however, NEPA does not compel agencies to act on these factors, nor does it expand the range of actions agencies may take beyond their existing statutory authorities.

The Endangered Species Act (ESA) more directly promotes goals of the ecosystem approach by protecting native plants and animals—components of ecosystems—that are at risk of extinction. An explicit purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" (16 U.S.C. § 1531(b)). Under the ESA, federal agencies must ensure that their actions are not likely to jeopardize the continued existence of listed endangered and threatened species or to adversely modify the designated critical habitat of such species (16 U.S.C. § 1536(a)(2)). Federal agencies are also directed to utilize their authorities to "conserve" listed species, which includes supporting their recovery so that they can be removed from the federal list of threatened and endangered species. In addition, federal and non-federal entities and individuals are prohibited from unauthorized "taking" (including harming or killing) of listed species (50 CFR § 17.3). Despite these directives, the emergency-room nature of the ESA, in the absence of other preventive efforts, has limited its effectiveness in maintaining biodiversity and ecosystem health. To move toward more flexible, cost-effective preventive management, the U.S. Fish and Wildlife Service and National Marine Fisheries Service recently established a policy to take an ecosystem-oriented approach in administering the ESA.

Pollution control laws provide additional legal foundation for achieving goals of the ecosystem approach. For example, the Clean Water Act

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(CWA) grants the Environmental Protection Agency (EPA) authority to promote the integrity of aquatic ecosystems when approving state water quality standards (see, *e.g.*, CWA § 303(c), which mandates consideration of use of a body of water for propagation of fish and wildlife). Section 303(c) of the CWA also authorizes adoption of site-specific water quality standards to take into account considerations unique to particular ecosystems. The CWA also directs EPA to develop water quality criteria that reflect the latest scientific knowledge of “the effects of pollutants on biological community diversity” to guide states as they establish their water quality standards (CWA § 304(a)(1)).

Several other pollution control statutes allow for or mandate the protection of ecosystems:

- The Federal Insecticide, Fungicide, and Rodenticide Act stipulates that pesticides may not be registered or reregistered if they result in “unreasonable adverse effects on the environment,” including “water, air, land, and all plants and man and other animals living therein, and the interrelationships which exist among these” (7 U.S.C. §§ 136a(c)(5), 136(j)).
- The Clean Air Act requires EPA to establish secondary national ambient air quality standards that “protect the public welfare” (§ 109(b)(2)). It also gives authority to federal land managers to protect air quality related values of Class I areas, including certain national parks and wilderness areas (§ 165(d)), and it prevents stationary sources of air pollution in nonattainment areas from constructing or modifying their facilities unless an analysis of alternatives demonstrates that the benefits outweigh the environmental costs (§ 173(a)(5)).
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that consideration be given to “the potential for destruction of sensitive ecosystems” when establishing hazardous waste site cleanup priorities (§ 105(a)(8)).
- The Resource Conservation and Recovery Act establishes a program for regulating

hazardous waste so as to protect “human health and the environment” (§ 1003(a)).

- The Toxic Substances Control Act requires EPA to regulate chemical substances and mixtures found to pose an unreasonable risk of injury to the environment (15 U.S.C. § 2603).
- The Oil Pollution Act and CERCLA allow funds recovered in a natural resource damage lawsuit to be used for broad environmental restoration in the area injured by oil or hazardous substance spills.

Numerous other federal statutes provide significant authority to protect biodiversity and ecosystem function across a broad range of ecosystems, including forest, terrestrial, aquatic, and marine systems. For example, the Migratory Bird Treaty Act (16 U.S.C. §§ 703 *et seq.*) protects migratory birds, and related laws provide for acquisition of habitats. The Lacey Act and Lacey Act Amendments of 1981 (18 U.S.C. § 42(a)(1) and 16 U.S.C. §§ 3371 *et seq.*) prohibit the importation into the United States of wildlife that might deplete stocks of domestic wildlife or damage wildlife resources. The Fish and Wildlife Coordination Act (16 U.S.C. §§ 661 *et seq.*) requires that wildlife concerns receive equal consideration and be coordinated with other aspects of water resources development. The Non-indigenous Aquatic Nuisance Control Act (16 U.S.C. § 4701(b)(1)) provides authority to avoid stresses arising from the introduction of exotic species into aquatic ecosystems. The Marine Mammal Protection Act (16 U.S.C. §§ 1361 *et seq.*) places a moratorium on taking and importing all marine mammals (with some exceptions), and authorizes regulations to protect rookeries, mating and feeding grounds, and other significant habitats for some stocks. In accordance with the Federal Power Act (16 U.S.C. §§ 791 *et seq.*), the FERC must adequately and equitably protect, mitigate damages to, and enhance fish and wildlife affected by hydropower projects.

Finally, general direction to contribute to the protection of ecosystem integrity can be found in the organic statutes governing the activities of “mission” agencies. For example, the Intermodal Surface Transportation Efficiency Act requires statewide planning of transportation projects and integration of transportation issues with social,

economic, and environmental concerns. The Water Resources Development Act (WRDA) of 1990 (§ 306) makes environmental protection one of the primary missions of the U.S. Army Corps of Engineers (Corps) in planning, constructing, operating, and maintaining water resources projects. The WRDA of 1986 (§ 1135), as amended by the WRDA of 1990 (§ 304) and 1992 (§ 202), gives the Corps the authority to modify the structures and operations of projects to improve the quality of the environment. In addition, individual project authorizations can include environmental restoration features.

Statutes governing management of federal lands. Federal land management laws provide clear authority to maintain ecosystem integrity on federal lands. The Multiple Use–Sustained Yield Act includes a mandate to administer national forests “for outdoor recreation, watershed, and wildlife and fish purposes” as well as for range and timber purposes (16 U.S.C. § 528). The National Forest Management Act requires that the Forest Service “provide for diversity in the multiple-use context” (16 U.S.C. § 1604(g)(3)(B)(1988)—see also 36 CFR § 219.19, which requires the maintenance of viable, well-distributed populations of native and desired nonnative vertebrate species). Forest planning must follow guidelines that, among other things, “provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives” (16 U.S.C. § 1604(g)(3)(B)).

The Federal Land Policy and Management Act (FLPMA) requires that the Bureau of Land Management manage its lands for multiple uses, but avoid “permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output” (43 U.S.C. § 1702(c)). FLPMA also declares a policy of management to protect scientific, scenic, ecological, environmental, and water resource values.

Other statutes provide for the protection of large reserves. The purpose of the Wilderness Preservation System is “to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its

possessions, leaving no lands designated for preservation and protection in their natural condition” (16 U.S.C. § 1131(a)). Thus, the express intent of the Wilderness Act includes maintaining conditions that can contribute significantly to sustaining the health of the ecosystems of which wilderness areas are a part. The National Park Organic Act requires the National Park Service to administer the national park system to conserve scenery, natural and historic objects, and wildlife, and to provide for public enjoyment while ensuring that the parks are left “unimpaired for the enjoyment of future generations” (16 U.S.C. §§ 1 *et seq.*). Similarly, the Alaska National Interest Lands Conservation Act (16 U.S.C. §§ 3101 *et seq.*) reserves vast acreage in Alaska for wilderness and multiple uses. The National Park Service has in the past relied upon existing legal authority to respond to activities outside the parks that threaten to degrade parklands.

Several acts governing the National Wildlife Refuge System provide for the preservation of land areas needed for refuge purposes, including the National Wildlife Refuge System Administration Act (16 U.S.C. §§ 668dd *et seq.*), Refuge Recreation Act (16 U.S.C. §§ 460k *et seq.*), and Refuge Trespass Act (18 U.S.C. § 41). Wildlife refuges are managed primarily for the benefit of wildlife, particularly endangered and threatened species and waterfowl. All uses of refuges must be compatible with the primary purpose of the refuge designation. To date, the Fish and Wildlife Service has allowed a wide variety of uses under this provision, including military activities, mining and other extractive industries, and livestock grazing.

The national park, refuge, and wilderness laws seek to maintain the ecological health of protected areas, but these lands generally do not encompass entire landscape ecosystems. In some cases, particularly when establishing national parks, Congress has delegated its Property Clause power to protect national reserves from external threats. In addition, the reserved water rights doctrine authorizes land management agencies, where they have senior rights, to protect federal reserved lands from extraterritorial activities (particularly water diversions) that are inconsistent with the reserves’ primary purposes.

Existing public land law thus provides numerous opportunities for pursuing the goal of maintaining

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ecosystem health and biodiversity. To take advantage of these opportunities, appropriate coordinated modifications of regulations, policies, and guidance could be made to incorporate these goals more clearly into agency procedures.

Statutes aimed at congressionally designated ecosystems. Federal statutes provide direction to restore and maintain the integrity of specially protected or specifically designated ecosystems. In these statutes, Congress either establishes relevant boundaries itself or directs agencies to do so. Several statutes provide protection for particular ecosystem types:

- The Coastal Zone Management Act—designed to preserve and protect the nation's coastal zone—provides federal grants and technical assistance to encourage states to implement coastal zone management programs that include provisions to protect wetlands, floodplains, estuaries, and fish and wildlife and their habitat (16 U.S.C. § 1452). The Coastal Zone Management Act also requires that activities affecting a state's coastal zone that are undertaken, financed, or permitted by federal agencies be conducted consistently with approved state coastal management programs (16 U.S.C. § 1456). The Act also established the National Estuarine Research Reserve System program, designed to create and manage a national system of estuarine research reserves through federal-state partnerships for long-term research and monitoring, public education and interpretation, and the development of more informed coastal zone management decisions. The Coastal Zone Act Reauthorization Amendments of 1990 (16 U.S.C. § 1455b) require states with approved coastal zone management programs to develop projects to control coastal nonpoint source pollution. The Coastal Barrier Resources Act (16 U.S.C. §§ 3501–3510) seeks to minimize damage to natural resources associated with coastal barriers by restricting “future Federal expenditures and financial assistance” that encourage development of coastal barriers.
- The Wild and Scenic River Act (16 U.S.C. § 1271) allows rivers “with their immediate environments, [which] possess outstandingly remarkable scenic, recreational, geologic,

fish and wildlife, historic, cultural, or other similar values,” to be preserved in free-flowing condition.

- The Marine Protection, Research, and Sanctuaries Act (16 U.S.C. §§ 1431 *et seq.*) authorizes establishment of marine sanctuaries and creation of management plans to achieve comprehensive and coordinated conservation of resources while facilitating uses to the extent compatible with protection.

In addition to special ecosystem types, federal statutes also provide protection for designated ecosystems. For example, to facilitate protection of the New Jersey Pinelands, Congress created the Pinelands National Reserve in 1978, specified guidelines for its protection, and authorized the establishment of the Pinelands Commission. The Coastal Wetland Planning, Protection, and Restoration Act establishes a task force comprised of federal and state representatives to develop a “comprehensive approach to restore and prevent the loss of coastal wetlands in Louisiana” (16 U.S.C. §§ 3951–3956).

Furthermore, several Clean Water Act provisions allow for research programs and collaborative watershed or ecosystem plans to be established for the protection of wildlife, aquatic life, and biological resources in specifically named ecosystems. The Clean Water Act calls for protecting “living resources” in Chesapeake Bay (§ 117) and “aquatic life and wildlife” in the Great Lakes (§ 118), and for developing plans to maintain the chemical, physical, and biological integrity of estuaries nominated by states as estuaries of national significance (§ 320).

Although the statutes and regulations discussed above all support goals of the ecosystem approach, many were promulgated years ago and could be administered more effectively if used consistently to restore and maintain the biodiversity, health, and sustainability of ecosystems. To take better advantage of these authorities under existing law, agencies could review their current regulations and policies to ensure that they are fully utilizing their discretion to do so.

In addition, although all of the federal laws described above can contribute to ecosystem protection, ecosystems throughout the country can be

adversely affected by other federal activities and financial incentives—see, for example, the Secretary of the Interior's report to Congress on "The Impact of Federal Programs on Wetlands" (1994). The adverse impacts of federal programs in water development and management, agriculture, infrastructure, local development, and housing could all be reviewed to identify ways to ensure that they do not impair long-term ecosystem health. Similarly, federal programs and tax incentives that promote unsustainable resource use, extraction, and development could be reviewed for possible changes.

Promoting Sustainable Communities and Economies

Several federal statutes provide federal agencies with the authority to promote sustainable economic development and community stability. Through the National Environmental Policy Act (NEPA), Congress declared a national policy "to use all practicable federal means and measures to harmonize human activity with environmental conditions to fulfill the social, economic, and other requirements of present and future generations of Americans" (42 U.S.C. § 4331(a)). Regulations of the Council on Environmental Quality promulgated under NEPA provide for consideration of cultural, economic, and social (as well as ecological) effects of agency proposals (40 CFR § 1508.8). In addition, under these regulations agencies must consider indirect effects of their proposals, including induced growth, changes in land use, and population density and growth (40 CFR § 1508.8).

On February 11, 1994, President Clinton signed Executive Order 12898 ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"). The Order directs federal agencies to make environmental justice part of their missions by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects in minority communities and low-income communities. As highlighted in the presidential memorandum issued with the Order, the Order is designed to focus the attention of federal agencies on the human health and environmental conditions in these communities in order to realize the goal of environmental justice. The President's memorandum accompanying Executive Order 12898 directed federal agencies to use the NEPA process to identify and address, as appropriate, disproportionately high and adverse human health or

environmental effects in minority and low-income communities.

Addressing or avoiding disproportionately high and adverse health or environmental effects on minority populations, low-income populations, and Native Americans will contribute to the ecosystem approach's goal of promoting sustainable communities. Similarly, ensuring that the natural infrastructure and capital of these communities is not disproportionately weakened over time will contribute to the short- and long-term sustainability of their economies. Overall, NEPA and executive policy provide a sound basis for agencies to more thoroughly evaluate regional demographic and economic trends and other factors pertaining to quality of life.

The U.S. Department of Agriculture (USDA) and U.S. Department of the Interior have specific authorities to promote sustainable economies and communities on and off federal lands. The multiple-use and sustained-yield directives in the Multiple Use-Sustained Yield Act, National Forest Management Act (NFMA), and Federal Land Policy and Management Act provide an opportunity for promoting sustainable economies and communities. NFMA contains provisions that facilitate the ecosystem approach, such as requirements concerning public participation, resource inventories, intergovernmental coordination, monitoring of resource condition, and conservation of diversity of plant and animal communities in the multiple-use context. NFMA and its regulations also require the agency to devote resources to forecasting commodity production, including estimation of allowable timber sale quantity, timber sale schedules, rangeland grazing suitability, recreation demand, and future mineral development. Communities, businesses, and financial institutions have in the past relied on such data from forest plans in their decisionmaking. Some have challenged federal land managers' efforts to create ecosystem-based land management plans. These organizations look to forest plans for long-term stability in commodity production. However, the ecosystem approach works best when plans can be rapidly altered to respond to unforeseen circumstances or new information. Thus, there is some tension in the NFMA between commodity production and the ecosystem approach. Nonetheless, the use of ecosystem plans under NFMA should lead to more ecologically informed and sustainable decisions regarding commodity production.

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The Federal Land Policy and Management Act (FLPMA) requires the Bureau of Land Management to develop Resource Management Plans to govern federal land management, but is largely silent on their content. This flexibility may assist the agency in promoting elements of an ecosystem-based approach to managing resources. First, FLPMA provides authority for preparing and maintaining an inventory of public lands and resources, giving priority to areas of critical environmental concern. Second, in developing land use plans, the Bureau of Land Management is to use an "interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences." Third, Congress emphasized the need for land use planning, including coordinated planning with other federal and state planning efforts. Fourth, Congress added that "management [should] be on the basis of multiple use and sustained yield unless otherwise specified by law." These goals are based on recognition that "the nation's need for domestic sources of minerals, food, timber, and fiber" must be considered and reconciled with a policy to "protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values," and, "where appropriate," to "preserve and protect certain public lands in their natural condition," providing "food and habitat for fish and wildlife and domestic animals," and also providing "for outdoor recreation and human occupancy and use."

Thus it appears that the FLPMA's multiple-use, sustained-yield focus is consistent with an ecosystem approach to land management. The focus of current planning regulations is not to assign priority to any use, but rather to provide for the management of lands with the widest range of beneficial uses achievable without undue environmental degradation, risk to health or safety, or other undesirable consequences. To the extent that certain decisions can be implemented only through a land use planning process and must be consistent with a land management plan, making rapid changes can prove awkward when agencies are practicing adaptive management and coordinating and working with other resource-managing agencies and stakeholders. Additionally, the Bureau of Land Management's authority to manage lands may also be constrained when land is dedicated to a specific use according to other provisions of law, in which case the land is managed in accordance with such law.

In a few cases, lands are also managed under specific statutory mandates that may constrain land management options. For example, the Oregon and California Railroad and Coos Bay Wagon Road Grant Lands Act (O&C Act) provides for "permanent forest production" on O&C lands designated as timberlands in Oregon and California. It also provides for the leasing of O&C lands suitable for grazing. Money derived from the O&C lands is to be covered into a special fund, part of which is paid out to the counties in which the O&C lands are located. The O&C Act provides that timberlands shall "be managed . . . for permanent forest production, and the timber thereon shall be sold, cut, and removed in conformity with the principal [sic] of sustained yield for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating stream flow, and contributing to the economic stability of local communities and industries, and providing recreational facilities [sic]." This language suggests opportunities for an ecosystem approach to management: although timber production has been interpreted to be the "dominant use" designated by the Act, it is clearly not the only use. Moreover, notwithstanding its traditional interpretation, the Act itself does not state that timber production is its primary purpose. It does not define permanent forest production, but rather leaves this up to the Secretary of the Interior, vesting the Secretary with wide discretion in determining sustained yield and how to achieve it.

The National Forest Dependent Rural Communities Economic Diversification Act of 1990 includes a provision for the establishment of "rural forestry and economic diversification action teams," which would "prepare an action plan to provide technical assistance to economically disadvantaged communities" (7 U.S.C. § 6613). Action plans would provide financial as well as technical assistance. Other cooperative forestry assistance programs designed to foster sustainable communities and economies include the USDA Forest Service's Forest Stewardship Program, Stewardship Incentive Program, and Forest Legacy Program. The USDA Natural Resources Conservation Service has authority to provide assistance to and advise private landowners on numerous natural resource planning and conservation issues, including water supply, crop regulations, and land use planning.

The need to balance coastal economic development with protection of coastal ecosystems is a

major focus of the Coastal Zone Management Act, 16 U.S.C. §§ 1451 *et seq.* The Act has specific provisions for Special Area Management Planning, one of the management tools that state coastal programs can use to address issues that require more intensive planning and interagency coordination for areas of conflicting land and water uses, such as ports, harbors, waterfronts, and urban coastal areas.

Finally, pollution control statutes frequently allow or require agencies to consider socioeconomic costs and benefits. Barriers may exist to ecosystem-level application of many of these provisions, however, because they involve national standards or industrywide considerations. Nevertheless, agencies could seek to address regional or local circumstances more routinely, where appropriate and consistent with existing law.

General guidance for promoting community stability, sustainable economic development, and the productive potential of ecosystems could help shape agencies' efforts to implement the ecosystem approach. Through guidance from the Council on Environmental Quality, the socioeconomic analysis requirements of NEPA could be readily adapted to encourage agencies to consider whether their actions promote sustainable economies and communities. Principles or general criteria for assessing important issues, such as community stability or maintaining the productive potential of ecosystems, could help inform agencies' socioeconomic impact analysis. Guidance could also set forth common mitigation opportunities, alternatives, and available tools for considering whether agency actions promote sustainable economies and communities. Such guidance could also help minimize litigation risks in this area.

WORKING AND COORDINATING ON AN ECOSYSTEM SCALE

A fundamental tenet of the ecosystem approach is that planning and management must be based on or account for ecological boundaries. Generally, laws in the United States that affect environmental management have been developed in an uncoordinated, piecemeal fashion. They often apply nationally or (in the case of land management) to lands within a particular agency's jurisdiction, with little consideration given to how regional or local ecosystems function. Still, there are crosscutting

authorities that provide for an ecosystem-scale approach to management. Moreover, some state and federal statutes are written to create efforts to implement the ecosystem approach in designated areas. These latter statutes are regarded as particularly effective.

One of the most important ways to achieve an efficient, effective ecosystem approach is through interagency coordination. The Vice President's Report of the National Performance Review cited improved coordination among federal agencies as a major purpose of the ecosystem approach, and a major tool for achieving it. Nevertheless, the vast majority of federal statutes were not written with interagency coordination in mind; and the federal agencies' differing missions further complicate coordination.

This section describes existing authorities that may be used to promote an ecosystem orientation and practical problems that need to be resolved to make such an approach effective. Four types of legal authorities are discussed: (1) statutes that apply in all ecosystems; (2) statutes that govern the approach to managing federal lands; (3) statutes that include coordination mechanisms for specific geographic areas and specially protected ecosystems; and (4) other legal mechanisms relevant to achieving an ecosystem orientation.

Statutes That Apply in All Ecosystems

A number of federal legal authorities are available for use in implementing the ecosystem approach in all ecosystems nationwide. Such statutes include the National Environmental Policy Act, laws protecting elements of native biodiversity (such as the Endangered Species Act), pollution control and cleanup statutes (such as the Clean Water Act), and the authority of mission agencies.

National Environmental Policy Act. The National Environmental Policy Act (NEPA) requires federal agencies to consider the effects of their actions at the ecosystem scale. The most familiar NEPA mandate requires every proposal for a major federal action that significantly affects the human environment to be accompanied by a "detailed statement," which typically takes the form of an environmental impact statement (EIS). The coordination needed to prepare an EIS can be

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a major source of interagency exchanges of information on ecosystems and impacts of federal actions on them.

NEPA and its corresponding regulations from the Council on Environmental Quality (CEQ) call for consideration of ecosystem-level effects, alternatives, and mitigation opportunities across environmental media and jurisdictions (42 U.S.C. §§ 102(2)(C) and (E), and 40 CFR §§ 1502.14(f) and 1502.16(h)). NEPA requires federal agencies to consider the ecological consequences of their actions, including impacts not related to their organic statutes. The CEQ's regulations require agencies to consider the direct, indirect, and cumulative effects of their actions and connected actions. Indirect effects include "growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR § 1508.8). Importantly, "effects" also include "ecological" impacts, "such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems" (*id.*). NEPA requires that closely related actions be evaluated in a single impact statement, and allows agencies to conduct broad impact analyses to evaluate multiple proposals that are related geographically or have similar impacts (§ 1502.4).

At the beginning stages of developing an EIS, NEPA requires federal agencies to consult with any other federal agency that has "jurisdiction by law or special expertise with respect to any environmental impact involved" (42 U.S.C. § 4332(2)(C)). Furthermore, "affected" federal and nonfederal agencies must be notified of the proposed action and afforded an opportunity to comment on the proposal (40 CFR § 1501.7). An EIS must include a discussion of "possible conflicts between the proposed action and the objectives of Federal, regional, State, and local . . . land use plans, policies and controls for the area concerned" (40 CFR § 1502.16(c)). Finally, CEQ regulations require agencies to obtain comments on draft EISs from any federal agency with jurisdiction over any environmental impact involved, to request comments from other stakeholders, and to respond to all substantive comments (40 CFR § 1503). Courts have interpreted the consultation provisions under NEPA to require agencies to give careful consideration to the concerns voiced by

other agencies.* The CEQ mediates and issues recommendations and findings where interagency disagreements lead to a referral from another agency (see 40 CFR §§ 1504.1–1504.3).

CEQ regulations require designation of a lead agency to supervise preparation of an EIS, if more than one federal agency is involved in the same proposal or in actions that are related by functional interdependence or geographic proximity (§ 1501.5). Federal, state, and local agencies may act as joint lead agencies where there is at least one federal agency; CEQ regulations provide a detailed framework for the designation of lead and cooperating agencies. A lead agency is responsible for organizing the joint environmental analysis, requesting participation by other agencies, and using the analysis and proposals of cooperating agencies (§ 1501.6(a)). Where requested by the lead agency, cooperating agencies must normally participate in the NEPA process, providing staff at the lead agency's request and assuming responsibility for environmental analysis in their particular areas of expertise (§ 1501.6(b)). However, this approach to environmental analysis may be underutilized because lead agencies are not required to designate cooperating agencies.

The National Performance Review suggested the use of interagency teams for implementing the ecosystem approach. Regional and subregional ecosystem assessments, planning, and goal setting could be carried out by these teams and/or in other appropriate fora, as has occurred in the Pacific Northwest and South Florida. There are several options for most effectively performing such assessments and formulating goals for the ecosystem approach. The NEPA process could be used proactively as a framework for ecosystem planning through interagency environmental analyses that address regional and subregional issues pertaining to the ecosystem. Interagency cooperation could also increase if agencies took greater advantage of NEPA authority to prepare joint EISs and/or to enter into regionally based Memoranda of Understanding to integrate their NEPA activities.

*In several cases, courts have relied upon information or comments submitted by other agencies to question the adequacy of environmental documentation supporting a challenged development proposal. See *Foundation for North American Sheep v. United States*, 681 F. 2d 1172, 1178–79 n. 31; *Thomas v. Peterson*, 753 F. 2d 754, 759 (9th Cir. 1985).

Memoranda of Understanding and joint EISs could be established among federal, state, tribal, and local governments.

In some cases, programmatic EISs may be required under NEPA for activities to implement the ecosystem approach on a regional scale. Whether a programmatic EIS is required as a legal matter for ecosystem-based plans depends on the scope of the impacts evaluated and whether the proposed action is a "program" (see *Kleppe v. Sierra Club*, 427 U.S. 390 (1976), including extant NEPA analyses). Agencies may also decide to conduct voluntary interagency programmatic NEPA analyses of planning efforts, even though they are not required by NEPA. Such interagency ecosystem analyses may be organized along regional ecosystem boundaries or in high-priority smaller ecosystems. Through a system of coordinating all federal environmental analyses in a region, agencies and the public could receive a clearer picture of federal actions in the region than is currently provided by the piecemeal development and public distribution of site-specific NEPA documents. The "tiering" of site-specific analyses to programmatic EISs could allow agencies to conduct site-specific NEPA processes more quickly and efficiently by incorporating analyses already discussed in programmatic documents (40 CFR § 1508.28). For such an approach to work, agencies would need to agree on the type and format of environmental information to be contributed and made readily accessible.

Other benefits that could accrue from programmatic interagency NEPA analyses include: ensuring consideration of cumulative effects and management strategies at ecosystem scales that may be overlooked in site-specific NEPA documents; allowing agencies to share resources and expertise, and minimizing agency work at cross-purposes; creating a baseline for sharing information; reorienting environmental impact assessment towards proactive, preventive efforts in anticipation of issues before concrete federal proposals are made and before management and flexibility are reduced by species endangerment or other crises; and establishing coordinated monitoring approaches, and avoiding duplicative or ineffective monitoring at site-specific levels by different agencies.

Some agencies already use NEPA as a general planning framework for the ecosystem approach

through programmatic EISs. For example, the Tennessee Valley Authority, a government corporation with multiple mandates and a variety of authorities, has used NEPA to guide its Sound River Management strategy for operating its reservoir and navigation system and for environmental restoration in the Tennessee River watershed. The Tennessee Valley Authority has no direct environmental regulatory authority over the impairment of water in the Tennessee River watershed, but it uses its water quality monitoring programs and interagency/public involvement through the NEPA process to develop solutions to problems like point and nonpoint source pollution.

It may not always be to an agency's advantage to perform voluntary programmatic EISs in establishing plans for implementing the ecosystem approach. For example, some agencies already go through multiple levels of NEPA documentation, and an additional level may be an inefficient or ineffective use of resources. Agencies have also expressed the concern that because information regarding the appropriate ecological scale and the importance of ecosystem attributes is continuously evolving, programmatic EISs can be of limited usefulness and vulnerable to legal challenge. This concern underscores the need for a method of environmental assessment that can be continually and efficiently updated and adapted to changing conditions. However, methods of approaching problems of new information and supplementation under NEPA are discussed in the adaptive management section below.

One alternative to performing interagency programmatic EISs under NEPA is for agencies to voluntarily conduct strategic environmental analyses to improve and coordinate federal plans, programs, and resources in accordance with NEPA policies. These analyses would incorporate NEPA's goals and policies, but would not be subject to the CEQ's regulations because they would not evaluate a proposed action. Instead, they would serve as guide during consideration of ecological values and impacts early in agency planning processes and would not limit future agency options or prejudice ultimate agency decisions.

Preparing plans for implementing the ecosystem approach without using the conventional NEPA process has disadvantages. The action agency, other agencies, the public, tribes, and nonfederal government bodies may not become as rigorously

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involved in the impact assessment process as they would under the NEPA process, which is established and familiar to agencies and stakeholders. In addition, NEPA requirements often go into effect when agencies subsequently contemplate proposals for action; at this point, agencies would not be able to “tier off” voluntary strategic analyses, as provided under CEQ regulations. Where an action is part of a program that has been evaluated in a programmatic EIS, “tiering” allows the action’s EIS or environmental assessment to concentrate on the issues that are specific to the particular action, and to offer no more than a summary of the issues discussed in the programmatic EIS (40 CFR § 1502.20). Although information gathered for strategic plans could be incorporated into subsequent NEPA analyses, the information and analysis would be subject to NEPA’s coordination and public comment process. If issues are adequately addressed in a programmatic ecosystem-based plan prepared under NEPA, agencies may avoid unnecessary duplication of that analysis when addressing site-specific actions or impacts.

One concern raised in several survey team studies is the complexity of ambitious ecological impact analysis, particularly at multiple scales. Coupled with a lack of adequate information, this may place the analysis in doubt, creating litigation risks. NEPA addresses the problem of incomplete or unavailable data by requiring agencies to obtain information essential to a reasoned decision, provided the cost of obtaining it is not exorbitant (40 CFR § 1502.22). Where impact information is incomplete or unavailable, the agency must acknowledge this gap, explain the relevance of the missing information, summarize the scientific evidence available, and evaluate the potential impacts based on methods or approaches that are generally accepted in the scientific community. This approach was used successfully in developing the interagency Forest Plan in the Pacific Northwest. The Forest Plan EIS acknowledged the numerous uncertainties about many of the relationships between—and conditions of—the wildlife, forests, economy, and communities of the Pacific Northwest. The federal district court that reviewed the Forest Plan found that the agencies had adequately explained why conducting a particular owl population viability assessment was not feasible, and upheld the agencies’ finding that the EIS provided sufficient information to make a reasoned choice.

In addition, if agencies follow current or expanded CEQ guidance on ecological impact assessment, litigation risks should be further reduced, because CEQ’s views are entitled to substantial deference in the courts. To improve implementation and reduce litigation risk, CEQ could issue regulations or guidance, building upon its recent report on incorporating biodiversity into NEPA analysis (CEQ 1993). Among other things, the regulations or guidance could identify important ecological assessment techniques and core ecological issues, including multiple ecological scales and long-term ecological timeframes.

Apart from EIS requirements, NEPA’s provisions require federal agencies to “initiate and utilize ecological information in the planning and development of resource-oriented projects” and to ensure that the natural and social sciences are systematically used in all decisions that “may have an impact on man’s environment” (NEPA §§ 102(2)(A) and (H)). These NEPA provisions may be cited as the authority for incorporating ecosystem information in a broader range of decisions than simply those that require an EIS. The NEPA process also provides a significant opportunity for interagency coordination and consultation on individual agency proposals. However, despite the opportunities it creates for interagency collaboration, NEPA has not generally been used as a basis for coordinating federal activities on an ecosystem-wide scale. The processes of NEPA could be more effectively used to promote collaboration and consensus-building among agencies, and could serve as an important procedural mechanism for federal agency coordination in implementing the ecosystem approach.

Laws protecting elements of native biodiversity.

In addition to NEPA, there are various legal authorities that apply in all ecosystems and could be used to implement the ecosystem approach. They include statutes that allow for consideration of native biodiversity, such as the Endangered Species Act, Fish and Wildlife Coordination Act, Marine Mammal Protection Act, and Magnuson Fishery Conservation and Management Act.

Endangered Species Act. One of the purposes of the Endangered Species Act (ESA) is to “provide a means whereby the ecosystems upon which endangered or threatened species depend may be conserved” (ESA § 2(b), 16 U.S.C. § 1531(b)). The ESA provides a variety of authorities to

protect and recover endangered and threatened species, a necessary component of which is addressing declines in ecosystem health that have led to species decline and listing. It also authorizes agencies to protect species before the ESA management restrictions become necessary.

Single-species protection is an important aspect of the ESA. But the ESA also allows for an ecosystem-oriented approach to species conservation through group listings of species that inhabit the same ecosystem and through interagency consultation on "a number of similar individual actions within a given geographical area" (40 CFR § 402.14(b)(6)). For example, in preparing the President's Forest Plan, the Fish and Wildlife Service issued a biological opinion covering activities on 24 million acres of federal land. The Fish and Wildlife Service and the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service have recently adopted a formal policy to utilize ecosystem approaches more comprehensively. The Notice of Interagency Cooperative Policy for the Ecosystem Approach to the ESA (59 Fed. Reg. 34,273 (1994)) establishes a policy to "incorporate ecosystem considerations in [ESA] activities" concerning listing, interagency cooperation, recovery, and cooperative efforts. Under this joint policy directive, group listing decisions are made on an ecosystem-wide basis where possible, interagency ESA cooperation is directed at ecosystem restoration, and recovery plans are developed for entire ecosystems where multiple listed and candidate species occur. In addition, the habitat conservation planning option for nonfederal agencies under ESA section 10 allows for protection at the ecosystem level by facilitating multispecies conservation plans. Candidate and other nonlisted species may also be included in such plans on a voluntary basis to prevent their possible endangerment and listing in the future.

Although the ESA's focus has recently been broadened to incorporate an ecosystem approach more rigorously, in rare situations the ESA may constrain efforts to implement the ecosystem approach: under some circumstances, the needs of listed species may be inconsistent or difficult to reconcile in the short run with long-term ecosystem health and biodiversity goals. For example, the snail kite, a listed species, lives in altered habitat in the Everglades area. Efforts to restore the ecosystem's health, though beneficial to most

species, adversely affected the snail kite in the short term (see South Florida survey team study in volume 3 of this series, Interagency Ecosystem Management Working Group 1995).

The ESA's interagency consultation requirements have proven effective in ensuring that the Fish and Wildlife Service and National Marine Fisheries Service are involved in other agencies' decisions that may affect listed species. However, this approach is by nature reactive and resource intensive: agency resources have often been committed or options limited by the time consultation is required, and consultation on significant proposals takes at least 5 months. In part to address this problem, 14 federal agencies recently signed an interagency Memorandum of Understanding to promote more efficient, effective administration of the ESA. The Memorandum, among other things, commits the agencies to establish regional interagency working groups that will identify geographic areas within which agencies will cooperate and coordinate their activities. The agencies also agreed, as appropriate, to identify critical threats to native species and ecosystems in the geographic areas where they work. Another interagency Memorandum of Agreement among five agencies establishes a framework for cooperation to conserve unlisted but at-risk species through conservation agreements for groups of species and specific ecosystems.

Survey participants noted that the Fish and Wildlife Service and National Marine Fisheries Service spend much of their limited budget and personnel resources fulfilling consultation duties, making it difficult for them to participate in interagency efforts on a large scale. The Fish and Wildlife Service has found that participation in an interagency information-sharing group in the Southern Appalachians has allowed it to better inform agencies about potential effects of contemplated actions before formal consultation becomes necessary. Finally, the National Environmental Policy Act requires that, to the fullest extent possible, draft environmental impact statements be prepared concurrently with biological assessments and consultation under the ESA (40 CFR § 1502.25). However, more emphasis should be placed on consulting with the Fish and Wildlife Service and National Marine Fisheries Service from the outset in order to explore meaningful alternatives and to avoid potential ESA conflicts.

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Involving these two agencies early in an ecosystem approach planning process may help avoid actions that would adversely affect protected species, but it may not obviate the need for additional consultations on individual federal actions at the site-specific level (50 CFR § 402.16). The Fish and Wildlife Service and National Marine Fisheries Service should work with other federal agencies to define the appropriate approach to consultation in the context of the ecosystem approach and to supplement their regulations or issue guidance to support this approach.

Fish and Wildlife Coordination Act. Under the Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661 *et seq.*, federal permitting and licensing agencies must consult with the Fish and Wildlife Service, National Marine Fisheries Service, and relevant state resource agencies, as appropriate, concerning potential impacts on fish and wildlife, and possible mitigation measures. Additionally, agencies planning federally authorized projects (such as dams and channels) must solicit the views of the Fish and Wildlife Service or National Marine Fisheries Service, and those of the relevant state agencies. Federal permitting, licensing, and planning agencies are not required to adopt the recommendations of these agencies, but must give "full consideration" to their views in deciding whether to issue or condition a permit or modify proposed project plans. These requirements provide the Fish and Wildlife Service and National Marine Fisheries Service with an opportunity to make recommendations reflecting agency efforts to take an ecosystem approach in the vicinity of the proposed project.

Marine Mammal Protection Act. The Marine Mammal Protection Act (MMPA) provides for conservation and management of marine mammal species and stocks by placing a moratorium on taking and importing all marine mammals, with limited exceptions for purposes of public display or scientific research, to enhance the survival of species or stocks, or for reasons incidental to other lawful activities. The MMPA mandates that all stocks in U.S. waters be assessed and that efforts be made to restore them to optimum sustainable population levels, where consistent with the primary goal of maintaining the health and stability of marine ecosystems. Administration of the MMPA is split between the National Marine Fisheries Service and Fish and Wildlife Service.

Historically, management has focused on individual animals, stocks, or species, not on overall habitats or ecosystems. Interactions between marine mammals and fishery stocks and the effects of habitat degradation and pollution on marine mammal populations have been largely ignored, as have the effects of climate and regime changes. Amendments to the Act in 1994 allow regulation to protect rookeries, mating and feeding grounds, and other significant habitats for some stocks. They also highlight and emphasize preexisting authority to alleviate by regulation the impacts of habitat destruction on strategic marine mammal stocks, consistent with the MMPA's primary goal of maintaining the health and stability of marine ecosystems. In addition, the 1994 amendments require studies to be conducted to evaluate several different marine ecosystems or ecosystem aspects, such as the Gulf of Maine and Bering Sea, or the effects of California sea lions and Pacific harbor seals on the coastal ecosystems of Washington, Oregon, and California. These studies will be designed to identify research and management measures to restore or maintain the health and stability of marine ecosystems.

Broader authority to require regular assessments of ecosystem health in those systems in which marine mammals are present would further the ecosystem approach. Additional focus is also needed on marine mammal predator-prey interactions to determine how fisheries affect availability of food for marine mammals.

Magnuson Fishery Conservation and Management Act. The Magnuson Act authorizes the National Marine Fisheries Service (NMFS) to conserve and manage fisheries in the Exclusive Economic Zone and anadromous fish throughout their range. The Act establishes eight Regional Fishery Management Councils and charges them with preparing Fishery Management Plans, which are then implemented by the NMFS through regulation, and it requires the NMFS to conduct a comprehensive program for fisheries research. Areas of research include the interdependence of fisheries or fish stocks, the impact of pollution on fish populations, and the impact of wetland and estuarine degradation.

The Magnuson Act provides many opportunities for an ecosystem approach to management. It emphasizes fishery management on a regional basis, in

coordination with states. Key to the Act are the Fishery Management Plans developed by Regional Fishery Management Councils consisting of federal, regional, state, and local interests. Plans must include a description of the significance of habitat to the fishery and the effects that changes to that habitat may have upon the fishery. The Plans may also incorporate relevant fishery conservation and management measures of the nearest coastal states.

Fishery Management Plans can establish broad, uniform policies and practices for entire fisheries, transcending state boundaries, and may more appropriately address management decisions across natural ranges of fish populations. These plans provide a way to facilitate coordination of fisheries and to enhance compliance with other statutes, such as the National Environmental Policy Act and the Endangered Species Act. Although Regional Fishery Management Councils may not have authority to regulate all activities that affect fishery resources, the ecosystem approach would provide an opportunity for the Councils to establish a better working relationship with agencies that have other expertise and regulatory authorities. This would require well-defined working relationships between management agencies whose actions affect fish managed under a Fishery Management Plan. An example is the current effort to restore stocks of salmon that spawn in the Pacific Northwest.

The existing fishery management structure can facilitate the ecosystem approach from other perspectives as well. National Marine Fisheries Service regulations under the Magnuson Act may provide the most direct way to reduce ecosystem damage from such fishing activities as bottom trawling in the Bering Sea. Fishing regulations may also affect basic ecology. For example, fishing levels for groundfish off the northeast coast may be affected by the knowledge that if all groundfish are harvested, they may be replaced by dogfish, which are of lesser value. Accordingly, groundfish management may be modified to prohibit fishing beyond certain limits so that other species do not displace the target species. Conversely, in the Hawaiian lobster fishery, environmental productivity was high in the 1970s, but declined with worsening environmental conditions, requiring changes in fishery management. These situations do not require extensive interagency

cooperation, but rather enhanced knowledge of species interactions and a willingness to integrate ecological information into the fishery management process.

A major barrier to use of the Magnuson Act for the ecosystem approach is the single-species focus of Fishery Management Plans, despite the Act's call for conservation measures. Even in multispecies Fishery Management Plans, there is generally no ecosystem perspective, such as an in-depth analysis of predator-prey relationships.

Pollution control and cleanup statutes. Existing law provides the federal government with many tools for working and coordinating at an ecosystem scale to address pollution stressors. Nevertheless, efforts to implement existing law consistent with the goals and principles of the ecosystem approach could be expanded.

EPA media authorities and community-based environmental protection. EPA's media authorities provide significant opportunities for efforts at an ecosystem scale. National standards established under these authorities set a baseline of protection for ecosystems across the country. However, to complement these standards and tailor its programs to the needs of particular communities and places, EPA is seeking to translate its success at collaborative ecosystem-based efforts in the Chesapeake Bay, Great Lakes, and elsewhere to other areas around the country through community-based environmental protection (CBEP). The goals of CBEP are to protect and sustain healthy human and ecological communities through collaborative processes that develop common goals based on sound science, and that empower, inform, and equip those who make, participate in, and live with environmental management decisions. In its recent 5-year strategic plan, EPA committed to "upgrade its ability to protect, maintain, and restore the ecological integrity of the nation's lands and waters, including human health, urban areas, and plant and animal species, by adopting a place-driven focus." Although statutory barriers in some cases prevent establishing standards or technology requirements on other than a nation- or industry-wide level, EPA authorities offer numerous opportunities for providing community-based support to regional and local efforts to implement the ecosystem approach, as the following examples show.

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EPA continues to move toward implementing Clean Water Act programs on a watershed basis, including its water quality criteria/standard setting and point source permitting programs. In addition to ecosystem-based programs such as the National Estuary Program, the Clean Water Act contains a promising process for setting "total maximum daily loads" for pollutants on an ecosystem-wide basis. The total maximum daily load provision allows for development of a long-range plan using the best science available for achieving pollution reductions that consider all sources in a water body. In addition, under the Safe Drinking Water Act, the Sole Source Aquifer Program—which provides protection for aquifers that serve as critical sources of drinking water—is inherently place-based and includes regional involvement at the federal, state, and local levels.

Because of the discretion available to EPA in allocating resources for hazardous substance cleanups and the Comprehensive Environmental Response, Compensation, and Liability Act's (CERCLA's) broad statutory language, the Superfund program can also be used to support work and coordination at an ecosystem level. Most significantly, ecological impacts could be considered to a greater extent in setting priorities for use of resources under CERCLA. In issuing Resource Conservation and Recovery Act permits to hazardous waste management facilities, potential impacts on a targeted ecosystem could be considered to a greater extent in determining whether, or under what circumstances, to permit a facility in a particular location, or in developing permit conditions. Plans for implementing the ecosystem approach could be used in setting priorities for issuing permits, including corrective-action and postclosure permits, and for designing appropriate corrective action measures. Existing rules on facility management could also be modified to focus more on environmental impacts.

The Clean Air Act contains several provisions that provide opportunities for supporting a regionally based ecosystem approach. In "nonattainment" areas, pollution sources must obtain a permit to construct or modify a major stationary source. The state permitting authority must determine that the benefits of permitting the proposed source significantly outweigh the environmental and social costs imposed as a result of its location, construction, or modification. This gives states flexibility to require alternative sites, processes, and control

techniques (42 U.S.C. § 173(a)(5)). A similar provision appears in the Prevention of Significant Deterioration program, where a preconstruction permit is required for any new major stationary source or modification proposed in an attainment area (§ 165(a)(2)). In addition, the Prevention of Significant Deterioration program for "Class I" areas provides clear opportunities for maintaining the ecological integrity of specified national parks and wilderness areas. Finally, as a general matter, if a pollution source or combination of sources presents "an imminent and substantial endangerment to public health or welfare, or the environment," EPA may bring suit, issue an order to stop the emissions, or take other necessary action (§ 303).

Under the Federal Insecticide, Fungicide, and Rodenticide Act, EPA may act to prevent "unreasonable adverse effects on the environment" (including effects on ecosystems) by prohibiting or restricting the use of a pesticide in a specific geographical area (7 U.S.C. § 136a; *cf.* § 136(bb), where "unreasonable adverse effect" is defined to take into account social and economic factors). EPA may also specify the data necessary to determine whether a pesticide has an unreasonable adverse effect on a particular ecosystem and require submission of the data for registration or reregistration of that product (7 U.S.C. § 136a(c)(2)(B)). Registrants are also under an ongoing obligation to submit information that becomes available after registration regarding unreasonable adverse effects (7 U.S.C. § 136d(a)(2)).

The Toxic Substances Control Act provides broad authority to collect information that may be useful in determining whether the manufacture, processing, distribution in commerce, use, or disposal of a "chemical substance" or "mixture" presents an unreasonable adverse risk of injury to an ecosystem (15 U.S.C. §§ 2603, 2604, 2607, 2609, and 2610). In addition, with some restrictions, the Toxic Substances Control Act provides authority to take action, by rule, to protect against such risks, including action limited to a specific geographical area (15 U.S.C. §§ 2604 and 2605).

Finally, the principal opportunities for using authorities under the Emergency Planning and Community Right to Know Act (42 U.S.C. §§ 11001 *et seq.*) to advance regionally based ecosystem protection lie in affecting the chemicals

identified for reporting, using information on toxic releases, and taking ecological concerns into account in developing emergency response plans.

EPA's watershed approach. The Clean Water Act, 33 U.S.C. §§ 1251 *et seq.*, authorizes EPA to undertake permitting, enforcement, and funding activities to achieve the Act's objective of restoring and maintaining the "chemical, physical, and biological integrity of the Nation's waters." Based on years of collective experience in state and federal agencies, including the successes of the Great Lakes, Chesapeake Bay, Clean Lakes, Puget Sound, and National Estuary Programs, EPA has established the "Watershed Protection Approach" as the conceptual foundation for its many Clean Water Act programs. The Watershed Protection Approach, an early incarnation of the ecosystem approach, focuses on a water body's entire watershed, not just on a portion of it or on pollutants of concern. It is based on a flexible framework of guiding principles designed to unify existing water programs and to leverage non-EPA efforts so that management in a watershed is coordinated and system-based.

As with other efforts to implement the ecosystem approach to date, the key principles of EPA's approach include: involving stakeholders, including the people most likely to be concerned or most able to take action; identifying the primary threats to human and ecosystem health on a watershed basis; and selecting and taking corrective actions in a comprehensive, integrated manner, drawing on the full range of available methods, tools, and willing organizations.

In different watershed projects, EPA's role varies considerably, from convener or coordinator to approver, promoter, supporter, or implementor. In addition, several state agencies and EPA regional offices have taken steps to institutionalize the Watershed Protection Approach as the cornerstone of their aquatic resource management activities and have begun devising implementation frameworks. For example, EPA's Region 10 (which includes Washington, Oregon, Idaho, and Alaska) has identified approximately 35 watersheds in its jurisdiction and has prioritized them according to ecological importance. In high-priority watersheds, the region appoints a full-time coordinator, assembles a team of agency specialists to focus on the watershed, and works with other federal agencies and with state, local, and tribal governments and

interested private parties to address problems in the watershed. In lower priority watersheds, EPA plays a lesser role. It may, for example, simply organize or attend local meetings.

In the survey team study on the Pacific Northwest forests, personnel from EPA Region 10 identified several impediments to EPA's Watershed Protection Approach. First, the Clean Water Act does not include an effective program for nonpoint sources such as agriculture, which are often a major source of water pollution. As part of the effort to reauthorize the Clean Water Act last year, the Administration advocated an amendment that would have required states to expand their existing nonpoint source management programs to implement best available management measures for categories of nonpoint sources that cause or significantly contribute to water quality impairments or threatened impairments. Among other things, the Administration sought authority for EPA to establish enforceable minimum nonpoint source controls where a state failed to develop an approvable program and to take enforcement action in certain circumstances. Second, development of complex total maximum daily loads under section 303(d) of the Clean Water Act often demands significant state and federal agency resources and therefore may discourage widespread use of those authorities. For this reason, EPA is promoting the development of less complex total maximum daily loads where appropriate. A third nonlegal but resource-related issue is that EPA officials find it difficult to start up local watershed planning efforts and then not follow through with funding. After EPA gets involved in a local effort, it is expected to stay involved and provide funding.

Clean Water Act section 404 program. Clean Water Act section 404 provides the Corps with authority to regulate the discharge of dredged and fill material into U.S. waters. The section 404 program was established to protect wetlands and other waters, thereby maintaining key components of the aquatic ecosystem. In addition, regulatory tools such as wetlands mitigation banking and other tools are used for the ecosystem approach.

The section 404 permit program. In making day-to-day decisions on permit applications to discharge dredged or fill material into the waters of the United States (including wetlands), the Corps relies in part on substantive environmental criteria developed in conjunction with EPA. These

regulations, codified at 40 CFR Part 230, generally provide that no discharge of dredged or fill material will be permitted under the following conditions: if there is a practicable alternative to the discharge that would have fewer adverse impacts on the aquatic ecosystem; if the discharge would cause or contribute to violations of applicable environmental standards or jeopardize the continued existence of species listed as endangered or threatened under the Endangered Species Act; or if the discharge would cause or contribute to significant degradation of the waters of the United States. In addition, the discharge will not be permitted unless all appropriate and practicable steps have been taken to minimize its potential adverse impacts on the aquatic ecosystem. Section 404(c) of the Clean Water Act authorizes EPA to override issuance of a permit by the Corps or to prevent the Corps permit if EPA determines that the proposed project will have an "unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning or breeding areas), wildlife or recreational areas."

A fundamental limitation of the regulatory program as currently implemented derives from the fact that it is usually "reactive" in nature: the Corps must respond in a timely manner to requests from many parties for authorization for proposed activities in or affecting aquatic ecosystems. Consequently, the program typically deals with activities affecting ecosystems on a piecemeal, case-by-case basis, limited by jurisdictional barriers, staffing constraints, and other impediments. One key challenge the section 404 regulatory program faces is dealing effectively with the cumulative effects of the many and varied activities authorized under the program. Given the very limited time and resources available to the regulatory program (it authorizes tens of thousands of activities yearly), it is difficult to identify and evaluate the cumulative environmental effects of each proposed activity when considered in conjunction with past, present, and reasonably foreseeable future activities in the relevant watershed. Although the Section 404 regulatory program can make an important contribution to the ecosystem approach, it is not enough by itself.

Wetlands mitigation banking and other ecosystem-scale tools. The section 404 program can complement efforts to implement the ecosystem approach because it analyzes the potentially far-reaching

impacts of discrete activities that degrade wetlands and other waters of the United States and provides an opportunity for relevant resource agencies and other stakeholders to become involved. The Corps and EPA have used this authority to develop several watershed-based programs that could serve as tools for implementing the ecosystem approach. They encourage "mitigation banking," a practice of wetland restoration, creation, or enhancement to compensate for unavoidable wetland losses within the same watershed before those losses occur. Units of restored or created wetland values are expressed as "credits," and accumulated credits are withdrawn to offset "debits" incurred at a development site in the watershed. A related practice is the creation of offsite mitigation projects to compensate for section 404 violations.

The Corps has also employed the use of programmatic general permits. A programmatic general permit is developed by the Corps based on a strong state, regional, or local program that protects the aquatic environment. The programmatic general permit provides for a substantial reduction in duplication between the Corps' regulatory program and the nonfederal regulatory program because Corps review is expedited in reliance on the nonfederal program. When the nonfederal agency issues its authorization to proceed, the Corps quickly provides its approval, unless there is some aspect of the federal interest that requires additional review and attention.

When another governmental agency (part of state, regional, or local government, for example) develops a comprehensive watershed management plan, the Corps strives to establish a complementary programmatic general permit or a regional general permit that would regulate wetland losses. In either case, the Corps focuses compensatory mitigation requirements for these permits on wetland areas identified in the watershed management plan as priority restoration areas. Ideally, such priority areas for restoration of wetlands would be the subject of a wetlands mitigation bank. This would not only focus restoration on priority wetland areas identified by the nonfederal agency, it would also reduce the regulatory burden and increase predictability for potential permit applicants through advance identification of mitigation through the mitigation bank.

In addition, the Corps has instituted a program of Advanced Identification of Disposal Sites, under

which the agency may engage in advance planning in an entire watershed, focusing on watersheds where there is significant development pressure. The Corps, with input from EPA, designates areas as suitable or unsuitable for discharges of dredged or fill material, and prioritizes areas within a watershed for wetlands purposes. This program helps property owners or prospective buyers determine in advance the likelihood of receiving section 404 permits in specific areas. Criticisms of this program include the following: it is cumbersome; it fails to take into account such factors as water quality and socioeconomic impacts of wetland determinations; it does not allow for the stay of permit applications while a comprehensive analysis is being done; and it requires more resources than the Corps and EPA can usually devote to it.

Finally, the agencies can work with other federal, state, and local officials to craft a Special Area Management Plan, or modify other procedures or general permits to maximize the protection that the regulatory program can provide.

Restoration and response authorities under the Oil Pollution Act, Clean Water Act, and Comprehensive Environmental Response, Compensation, and Liability Act. Under the Oil Pollution Act (OPA), Clean Water Act (CWA), and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the federal government has various tools for environmental response and ecosystem restoration, including natural resource damage provisions and national contingency planning.

Natural resource damage provisions. Several federal environmental statutes authorize federal and state agencies and Indian tribes to act as trustees for natural resources injured, lost, or destroyed by discharges of oil or releases of hazardous substances into the environment (see CERCLA §§ 107(a) and (f), 42 U.S.C. §§ 9607(a) and (f); CWA §§ 311(f)(4) and (5), 33 U.S.C. §§ 1321(a) and (f); OPA §§ 1002 and 1006, 33 U.S.C. §§ 2701 and 2706). Monetary damages recovered under these statutes are to be used to "restore, replace, or acquire the equivalent of" resources injured by oil or hazardous substance spills (see, e.g., 42 U.S.C. § 9707(f)(1)). The natural resource damage provisions of the CERCLA and OPA provide a natural context for implementation of an ecosystem approach to restoration.

Natural resource damage provisions mandate that funds recovered in a natural resource damage lawsuit or settlement to be used for restoration of the affected resources. Damage assessment is compensatory. This is an unusual and beneficial arrangement, since ordinarily any funds recovered by the United States in an environmental lawsuit take the form of penalties, generally are deposited into the federal Treasury, and are used for actions other than to restore the injured resource. Under CERCLA and OPA, restoration must take place in the area injured by the spill. These statutes are directed at all resources and are not media-specific. By barring double recovery of natural resource damages, CERCLA and OPA encourage a cooperative effort among state, federal, and tribal trustees with jurisdiction over resources in the injured area or ecosystem.

At several sites, the natural resource damage programs of NOAA and the Department of the Interior are already based on the ecosystem approach. One example of how the program can be used to support the ecosystem approach is Commencement Bay, an urban estuary next to Tacoma, Washington. Under a settlement with the Port of Tacoma, natural resource trustees recovered \$12 million for damages to natural resources that will be used to develop and implement an ecological assessment of Commencement Bay and the watershed that drains into it. Select projects will be designed to enhance the functioning of the ecosystem as a whole. Under another settlement with two private parties, defendants are creating 3.3 acres of riparian and wetland habitat adjacent to a 1.7-acre area that is one of the few remaining original mudflats in Commencement Bay. The defendant who owns the 5-acre site has agreed to place a restrictive covenant on the deed for the property to allow it to remain as natural habitat in perpetuity. The natural resource trustees for Commencement Bay (two federal agencies, NOAA and the Interior Department; the state of Washington; and the Puyallup and Muckleshoot Indian Tribes), all of which have some jurisdiction over the affected resources, have been working together to assess damages to natural resources in the Bay and to jointly decide what projects to undertake.

A more ambitious project is under discussion for Elliott Bay, the urban estuary next to Seattle, Washington, and the Duwamish River that empties into it. The listing of several salmon species as threatened or endangered, and its potential impact,

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have become issues of enormous public importance in the Pacific Northwest because of the commercial, recreational, and symbolic importance of salmon. EPA, NOAA, the Department of the Interior, the state of Washington, the Suquamish Indian Tribe, and the Muckleshoot Indian Tribe, in consultation with local agencies, industry, and citizens, are working on a program for identifying the key factors limiting production of salmon in the Duwamish watershed. They will then create a watershedwide plan to help restore the Duwamish ecosystem and thus the salmon run. In their capacity as natural resource trustees, NOAA, the Interior Department, the state, and the tribes will use natural resource damage awards under CERCLA to help support this program. EPA and the state will use their enforcement authorities under the CWA and OPA to target violators in the watershed. This program represents an attempt to begin implementing the ecosystem approach on an interagency, watershedwide basis.

These examples of interagency ecosystem approaches can be replicated across the country. The natural resource damage programs of NOAA and the Department of the Interior, along with existing EPA and state watershed programs, provide a framework for interagency cooperation in identifying key problems in watersheds and developing practical measures to address those problems.

Natural resource damage assessment regulations under the OPA were published in proposed form by NOAA on January 7, 1994 (59 Fed. Reg. 1062), and were repropounded on August 3, 1995 (60 Fed. Reg. 39804). Among other things, the regulations allow agencies to combine funds recovered in several natural resource damage cases in a given region in order to fund a larger, long-term "Regional Restoration Plan." For example, because small oil spills are common, several of them often occur in a single area, and damage recoveries are not large. It is cost-effective and sensible from a restoration standpoint to combine these recoveries and plan a restoration over a large area.

National contingency planning. The CWA and CERCLA mandate the development of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide the organizational structure and procedures for preparing for and responding to discharges of oil

and releases of hazardous substances, pollutants, and contaminants. The NCP, among other things, specifies responsibilities among federal, state, and local governments and procedures for involving state governments in the initiation, development, selection, and implementation of response planning and actions. It establishes a National Response Team consisting of designated federal agency representatives, which is responsible for planning and preparedness activities at the national level, and Regional Response Teams comprised of designated representatives from each federal agency at the regional level and from state and local governments. The NCP also establishes area and local structures for planning and response and encourages nongovernmental participation in the effort. Accordingly, the NCP framework can serve as a model for incorporation of efforts to implement the ecosystem approach. The NCP is designed to provide for efficient, coordinated, and effective action to minimize damage from oil and hazardous substance discharges. Duties and responsibilities include water pollution control and conservation and trusteeship of natural resources (33 U.S.C. § 1321(d)).

The NCP thus establishes the integrating mechanism for intergovernmental planning. It also reinforces federal and state partnerships, defines agency roles, and requires that necessary budgetary and personnel resources be allocated to effectuate the Plan. The NCP offers a management structure that serves to promote cooperation among the numerous federal agencies with overlapping authorities and responsibilities. The Plan encourages dialogue among the numerous governmental agencies to support major planning and response functions. It also encourages public involvement by recognizing the interests and capabilities that private individuals, organizations, and public interest groups bring to the process, and by allowing for participation of these groups in the process.

Mission agencies' authorities. Legal authorities that apply in all ecosystems include the authorities of mission agencies. The Corps civil works program, the Federal Aid Highway Program, and the U.S. Department of Defense's natural resource initiatives all provide the federal government tools for implementing the ecosystem approach.

Corps civil works program. The Corps is responsible for planning, designing, constructing, and

managing water resources development and environmental restoration projects, regulating the disposition of dredge and fill materials in waters of the United States, and providing technical assistance to state, local, and tribal governments. Civil works projects include the construction of locks, dams, channels, and harbors for the purpose of providing inland waterway and deepdraft navigation, flood control, hydroelectric power, water supply storage, outdoor recreation, and fish and wildlife improvement. All water resources projects that the Corps constructs must be authorized by Congress, either individually or programmatically. These projects are typically authorized in biennial Water Resources Development Acts (WRDAs) and are funded by annual Energy and Water Development Appropriation Acts.

A number of statutory provisions authorize the Corps to consider environmental protection and restoration in water resources projects. For example, section 306 of the WRDA passed in 1990 (WRDA 90) provides that environmental protection is one of the primary missions of the Corps in planning, designing, constructing, operating, and maintaining water resources projects. Section 1135 of WRDA 86, as amended by section 304 of WRDA 90 and section 202 of WRDA 92, provides authority to modify the structures and operations of projects constructed by the Corps to improve the quality of the environment. The non-federal sponsor bears 25 percent of the construction costs and 100 percent of the costs of operating and maintaining the project. Section 204 of WRDA 92 provides for the beneficial use of dredged material from Corps navigation projects. Because the alteration of aquatic systems for development, flood control, and water supply diminishes their health and biodiversity, the Corps' broad environmental authorities create significant opportunities for supporting efforts to implement the ecosystem approach while fostering sustainable economies and communities. Individual project authorizations can also include environmental restoration features as well as flood protection and navigation projects.

Federal Aid Highway Program. The Federal Highway Administration provides ongoing financial assistance to states for construction of highways and related activities described in U.S. Code Title 23. Funds for this program are apportioned by Congress annually to each state from the federal government's highway trust fund, which is supported by the federal gasoline tax.

The Federal Highway Administration administers the Federal Aid Highway Program, which is a "federally assisted state program" (23 U.S.C. § 145). By delegation from the Secretary of Transportation, the Federal Highway Administration determines whether the requirements of Title 23 and other federal statutes (including the National Environmental Policy Act and Clean Air Act) have been met before approving the plans, specifications, and estimates for construction of a project pursuant to 23 U.S.C. § 106, which creates the contractual obligation of the United States to reimburse a state for the costs of construction. If the Federal Highway Administration determines that the requirements will not be met by a project as proposed, federal laws do not apply to the project.

Thus, the Federal Highway Administration's primary role is to ensure that federal requirements and conditions have been met when it provides funds for a project. Whether federally assisted or not, the selection of projects, establishment of alignments, purchase of real property, and employment of contractors are all undertaken by the state (or occasionally by its political subdivisions). The resulting transportation facility is owned, operated, and maintained by the state. If Federal Aid Highway funds are to be used, the Federal Highway Administration ensures compliance with federal requirements during the project development process pursued by the state. Federal requirements may be of a procedural nature (*i.e.*, National Environmental Policy Act or metropolitan and statewide planning under 23 U.S.C. §§ 134 and 135), or they may advance certain federal policies or interests (*i.e.*, 49 U.S.C. § 303 (section 4(f)), the Endangered Species Act, the Clean Air Act, or Davis-Bacon requirements). At a minimum, the National Environmental Policy Act process for particular projects could help in analyzing project consequences at an ecosystem scale and in assessing project effects on any ecosystem approach efforts already underway.

The Intermodal Surface Transportation Efficiency Act (ISTEA) revised the process under which state and local agencies must plan needed highway and transit improvements. Under 23 U.S.C. §§ 134 and 135 and regulations issued by the Federal Highway Administration and FTA, transportation projects must be planned through comprehensive statewide and metropolitan planning procedures. These procedures must integrate transportation issues with applicable social, economic, and environmental

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concerns, potentially including issues raised by efforts to implement the ecosystem approach.

ISTEA also allows states to use Federal Aid Highway funds for a wider variety of state activities (see especially 23 U.S.C. §§ 133(b), 133(d)(2), and 101), some of which could promote ecosystem approach objectives. Federal funds may also be used for the "mitigation of damages to wildlife, habitat, and ecosystems" caused by federally funded projects (23 U.S.C. § 133(b)(1)), and for wetlands banking (23 U.S.C. §§ 103(i)(13) and 133(b)(11)).

Department of Defense natural resource initiatives. The Department of Defense is investing in natural resource inventories and moving from a species-by-species management approach toward a more holistic ecosystem approach. Several Defense Department ecosystem approach initiatives are underway, including:

- The Mojave Ecosystem Management Initiative, a collaborative effort involving the Department of Defense, Department of the Interior, and others in identifying and implementing programs to promote the ecosystem approach throughout the Mojave Desert.
- A Biodiversity Initiative, in partnership with The Nature Conservancy and the Keystone Center, to develop recommendations for managing biodiversity on Defense Department lands in ways compatible with the Department's mission.
- An interagency effort, led by the Navy, to protect habitat and to control predators to protect endangered species and other wildlife resources on Guam.
- An Air Force initiative with The Nature Conservancy to develop a management system to consolidate information regarding endangered and threatened species.

In addition, the Army has developed the Integrated Training Area Management Program to enhance its management of training lands. The program integrates mission requirements with land management. It includes environmental awareness training and state-of-the-art rehabilitation technology.

Statutes That Apply to Federal Land Management

Another type of legal authority available for use in implementing the ecosystem approach applies to approaches used by federal agencies in land management. Specific statutes govern federal land management, federal land acquisition, and federal coordination with states in coastal zone management.

Land management statutes. Forest Service management authorities evolved from the 1897 Organic Act (30 Stat. 34–36), which established an agency "to improve and protect" the federal forests and vested it with broad authority "to regulate [the forests'] occupancy and use and to preserve the forests therein from destruction" (30 Stat. 35). The Multiple Use–Sustained Yield Act of 1960 (16 U.S.C. §§ 528–531) made express the Forest Service's authority to manage the national forests for multiple uses and to determine the balance of uses that best meets public needs and makes the most judicious use of forest resources. Finally, the National Forest Management Act of 1976 directs the Forest Service to use a systematic, interdisciplinary approach to conduct land and resource management planning in order to provide for multiple uses and sustained yield of forest resources (16 U.S.C. § 1604). Forest planning must follow guidelines that, among other things, "provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives" (16 U.S.C. § 1604(g)(3)(B)). Forest Service regulations provide detailed requirements for the development of Land and Resource Management Plans for individual units of the National Forest System, but also provide for planning on a regional level (36 CFR §§ 219.8 and 219.9). The regulations further direct that forest planning must "recogni[ze] that the National Forests are ecosystems and their management for goods and services requires an awareness and consideration of the interrelationships among plants, animals, soil, water, air, and other environmental factors within such ecosystems" (36 CFR § 219.1(b)(3)).

The Bureau of Land Management manages federal lands under a variety of authorities, including the Federal Land Policy and Management Act (FLPMA) of 1976 (43 U.S.C. §§ 1701 *et seq.*). FLPMA confirms the Bureau's authority to manage

federal lands for multiple uses and sustained yield. It declares a policy of management to protect scientific, scenic, cultural, recreational, ecological, environmental, and water resource values.

FLPMA requires the Bureau of Land Management to develop Resource Management Plans to govern federal land management, but is largely silent on their content. The agency also manages certain forest lands in the Pacific Northwest under the Oregon and California Lands Act, which provides that these lands will be managed "for permanent forest production . . . for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating stream flow, and contributing to the economic stability of local communities and industries, and providing recreational facilities" (43 U.S.C. § 1181a). Land management by the Forest Service and Bureau of Land Management is subject to the National Environmental Policy Act's requirement to consider the effects of proposed management on ecosystem components, structure, and function (40 CFR § 1508.8).

Other significant federal lands include the National Wildlife Refuge System and the National Park System. The National Park System is managed under a national park planning statute that requires all uses to be compatible with the mission of the National Park Service to conserve the scenery, natural and historic resources, and wildlife of National Park System units for the enjoyment and recreation of current and future generations.

The U.S. Departments of Defense and Energy are also significant landowners. The Department of Defense manages more than 25 million acres of land in the United States pursuant to statutes discussed in this chapter, including the Endangered Species Act and National Environmental Policy Act. Although the Department manages its properties primarily in accordance with its national defense mission, it recognizes its responsibility to conserve and protect natural resources on the property it controls. An ongoing challenge for the Department of Defense is to integrate its stewardship responsibilities with its prime mission of national defense. The Department is also subject to the Sikes Act (16 U.S.C. § 670a). Pursuant to this Act, Defense Department installations are authorized to enter into cooperative agreements with the Department of the Interior and host states, as appropriate, regarding conservation of fish and wildlife. Many installations have entered into such agreements. Department of Defense

Directive 4700.4, codified at 32 CFR Part 190 (Natural Resources Management Program) implements the Sikes Act. Amendments to the Sikes Act under consideration would expand its scope from fish and wildlife conservation to all natural resources and would also increase oversight by the Department of the Interior. The Department of Defense has testified before Congress that it supports the goals of the proposed amendments.

Typically, federal landowning agencies have independently managed their lands for individual agency purposes, without coordinating with other landowners in the same regional or local ecosystem, not even with adjacent federal landowners. Examples of incompatible uses by neighboring land managers exist in many forms and at many landscape scales; timber harvests on national park boundaries are perhaps the most graphic example. The General Accounting Office recently concluded that the federal land management agencies' efforts to coordinate their activities within ecosystems are also hampered by "separate, lengthy planning requirements" (General Accounting Office 1994, p. 54).

To better incorporate the principles of the ecosystem approach into national forest planning, the Forest Service has proposed changes to its National Forest Management Act (NFMA) regulations to simplify, clarify, and otherwise improve the planning process (see Proposed Rule, 60 Fed. Reg. 18886-18932 (Apr. 13, 1995)). These changes are based in part on a comprehensive study of the NFMA planning process that found current forest planning procedures to be detrimental to meaningful communication with the public and with other agencies, and to increase the time and cost of plan completion. The Forest Service also recognized the need to change its standardized analysis so that its managers could tailor national forest planning to the needs of a particular forest and to address ecosystem components. The proposed regulations would eliminate the lengthy 10-step planning process required for both significant amendments and revisions of forest plans, and the automatic requirement for an environmental impact statement. Instead, National Environmental Policy Act (NEPA) procedures would both guide the process of plan amendment or revision and determine the type of NEPA document to be prepared.

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To avoid administrative disruption, the proposed rules would not attempt to redraw national forest boundaries to reflect ecosystems. However, new regulations would mandate that planning efforts be coordinated between forests that share ecological characteristics, and would require that management practices in adjacent national forests be consistent with each other, taking into account common ecosystems across administrative boundaries. In addition, national forests could take ecosystems into account through simultaneous amendment or revision of forest plans to respond to changing conditions, with public disclosure of the changes and effects under NEPA. To support adaptive management and agency accountability, an annual monitoring and evaluation report would be required. Finally, the ecosystem approach would be implemented because forest plans are based on analysis and decisions made at any appropriate scale or covering any area of federal land, regardless of administrative boundaries (60 Fed. Reg. at 18898).

The Bureau of Land Management is working to restore and maintain the health of rangelands in cooperation with those who depend on these ecosystems. Building on existing Federal Land Policy Management Act rules, the Bureau is setting up Resource Advisory Councils in all Western states to provide for broader public involvement in the public land management process (60 Fed. Reg. 9894 (Feb. 22, 1995)). With the help of these Councils, the Bureau will identify acceptable or best grazing management practices needed to achieve rangeland health.

In several ecosystems, the federal government has successfully coordinated individual agencies' planning requirements in the context of interagency initiatives. For example, many of the issues regarding coordination of federal land management activities at an ecosystem scale were identified and addressed in the development of an interagency plan ordered by the President to ensure the coordinated management of Bureau of Land Management and Forest Service lands in the Pacific Northwest. This Forest Plan and programmatic environmental impact statement were developed by the Forest Service and Bureau of Land Management, as lead agencies, with the Fish and Wildlife Service, National Marine Fisheries Service, and EPA acting as cooperating agencies. The Forest Plan was designed to ensure preservation of the Pacific Northwest forest ecosystem and of

more than one thousand plant and animal species associated with it. The interagency plan established a coordinated system of protected areas and timber harvest as well as an aquatic ecosystem protection strategy that applied to both Bureau of Land Management and Forest Service lands within the Pacific Northwest forest ecosystem.

On December 21, 1994, the federal district that had previously enjoined all old-growth timber harvesting within the range of the northern spotted owl issued a decision rejecting all legal challenges to the Forest Plan. The court's order marks the first time in several years that these forests are being managed under a lawful plan, and "the first time that the Forest Service and Bureau of Land Management have worked together to preserve ecosystems common to their jurisdictions" (*Seattle Audubon Society v. Lyons*, Order at 2). In that decision, Judge William L. Dwyer found that the government had the authority to adopt an interagency plan on an ecosystem basis. Reviewing the disparate statutes that govern the federal forestlands, and the agencies' common authority under the National Environmental Policy Act and Endangered Species Act, the court concluded that "[g]iven the current condition of the forests, there is no way the agencies could comply with the environmental laws *without* planning on an ecosystem basis" (Opinion at 32, emphasis in the original).

To ensure that land management agencies coordinate more routinely in shared ecosystems, a review of agency planning processes should be undertaken to identify opportunities for increased cooperation, consistent with existing mandates.

Land acquisition authority. Federal land management agencies have several authorities allowing for acquisition or exchanges of land targeted by collaboratively developed ecosystem plans or to ensure the long-term health and productivity of existing public lands. The authorities also allow exchanges of land between federal agencies and nonfederal entities.

Section 205 of the Federal Land Policy and Management Act authorizes the Secretary of the Interior to acquire lands or interests in lands through purchase, exchange, donation, or eminent domain (under specified conditions), provided that the acquisitions are "consistent with the mission of the

department involved and with applicable departmental land-use plans" (43 U.S.C. § 1715). The Act, as amended by the Federal Land Exchange Facilitation Act (43 U.S.C. § 1716), authorizes an exchange when the Secretary determines "that the public interest will be well served by making that exchange." The Federal Land Exchange Facilitation Act establishes the general process for proceeding with a proposed intrastate exchange. The Bureau of Land Management already has acquired several thousand acres of critically important lands through exchanges, and it currently is considering a number of land exchanges designed to bring into federal ownership lands that could become preserves for endangered and other species.

Forest Service land exchanges are discretionary, voluntary real estate transactions between the Secretary of Agriculture (acting through the Forest Service) and private owners, states, and other non-federal entities (36 CFR § 254). Authorities for the exchange of National Forest System land and interests therein include the Weeks Act of 1911 (16 U.S.C. § 516), the General Exchange Act of 1922 (16 U.S.C. §§ 485 and 486), and the Bankhead-Jones Farm Tenant Act of 1937 (7 U.S.C. §§ 1010 and 1011(c)). The acquisition of property from voluntary sellers is also provided for by the Wild and Scenic Rivers Act (16 U.S.C. § 1277) and Wilderness Act (16 U.S.C. § 1134). These two authorities provide opportunities for the Forest Service to acquire lands that can anchor efforts to maintain the health and productivity of Forest Service lands and waters, and to maintain and protect ecosystems.

Both the Comprehensive Environmental Response, Compensation, and Liability Act and the Oil Pollution Act provide authority for federal trustee agencies to "acquire equivalent" natural resources using funds recovered in natural resource damage actions where there has been loss, injury, or destruction of natural resources. Trustees can use this authority to acquire land, taking ecosystem factors into consideration. In the area around Prince William Sound, state and federal trustees have acquired lands with funds collected from the settlement of the *Exxon Valdez* oil spill litigation. Land acquisition is proceeding on a willing-seller/willing-buyer basis, with an ecosystem approach in mind.

Land acquisition can serve several strategic purposes, including buffering for sensitive areas (The

Nature Conservancy 1991, 5–19). Agencies can make use of private organizations, including conservation groups, to assist where an agency acting alone would not be able to meet landowner needs. For example, where an agency identifies property it wishes to buy to support a community-based ecosystem effort, but for budget or other reasons cannot do so immediately, a private organization can purchase the land and convey the property to the government when it is able to purchase it. Private organizations can also assist in negotiating, expediting appraisals, and other activities related to land acquisition (The Nature Conservancy 1991, 3–56). There are some disadvantages to land acquisition as a method for the ecosystem approach. All acquisitions by the federal government must comply with uniform appraisal standards, and the federal government does not ordinarily purchase land with restrictions on it. In addition, land acquisition can be expensive; land requires maintenance after acquisition; and it is sometimes difficult to get landowners to sell their land in fee.

Statutes That Apply to Specific Areas and Ecosystems

Congress has enacted several statutes that direct agencies to protect certain ecosystem types, and other statutes that protect specific geographic areas. Compliance with many of these statutes requires interagency coordination.

Marine and coastal protection authorities.

Statutes designed to protect coastal and marine ecosystems provide important authorities for interagency work and coordination on an ecosystem-wide basis. These statutes include the Coastal Zone Management Act, National Marine Sanctuaries Act, National Estuary Program, and National Coastal Monitoring Act.

Coastal Zone Management Act. The Coastal Zone Management Act (CZMA), 16 U.S.C. §§ 1451–64, seeks to protect the nation's coastal zones through a cooperative federal–state effort. It gives the states primary responsibility for developing coastal resource management programs, through the development and implementation of coastal management plans. These plans must provide (among other things) for the following: protection of natural resources; management of coastal development; priority consideration of coastal-dependent uses and orderly processes for

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siting major facilities related to the national defense, energy, fisheries, recreation, and ports and transportation, and (to the maximum extent practicable) to location of new commercial and industrial developments; public access to coasts for recreation purposes; coordination and simplification of procedures to ensure expedited governmental decision making; continued consultation and coordination with affected federal agencies; and timely and effective notification of coastal management decision making, as well as provision of opportunities for public and local government participation in decision making.

NOAA has authority to approve or disapprove state programs. The coastal states have an incentive to obtain that approval: the federal government offers monetary assistance to participating states, which enjoy greater control over certain federal activities occurring in or outside of their coastal zones. The CZMA requires that all federal agency activities, or activities requiring federal authorization or receiving federal assistance, that affect the coastal zone be carried out in a manner that is consistent with the enforceable policies of approved state management programs.

Applicants for required federal licenses or permits to conduct activities that affect the coastal zone must certify that the proposed activity complies with the enforceable policies of the state's approved program. The CZMA also establishes the National Estuarine Research Reserve System to designate areas as biogeographic and topological representatives of estuarine ecosystems for long-term research and education.

The Coastal Zone Act Reauthorization Amendments of 1990, 16 U.S.C. §§ 1455b *et seq.*, require states with approved coastal zone management programs to develop coastal nonpoint pollution control programs, or else lose portions of funding received under both the Clean Water Act and the CZMA. Programs are geared to protecting coastal waters from sources of nonpoint pollution, including agriculture, forestry, urban development, hydromodification, and marinas.

The opportunities provided by the CZMA for the ecosystem approach are numerous:

- It provides for a comprehensive approach to the management of coastal and ocean ecosystems and resources, including planning for compatible economic development.
- It creates an ability for comprehensive review of and interagency coordination between state and federal government on federal agency activities in the coastal zone.
- It provides opportunities for participation in federal and state decisions that affect coastal ecosystems and establishes state-federal dispute mediation processes for federal activities affecting the coastal zone.
- Its coastal nonpoint source pollution control program provides the first nonpoint source control program required to be backed by enforceable policies and mechanisms; if successful, it will—in some states—provide this protection for the entire coastal watershed within its boundaries.
- Its National Estuarine Research Reserve System provides a unique opportunity to study estuarine ecosystems, test management practices, and demonstrate ecosystem approaches to conservation and management of coastal watersheds.

However, the ability of state governments to regulate activities affecting ecosystems may be limited by other federal laws. Federal agencies are excused from their obligation to conduct activities in a manner consistent with state coastal management plans when another federal law prevents such consistency.

National Marine Sanctuaries Act. The National Marine Sanctuaries Act (NMSA), 16 U.S.C. §§1431 *et seq.*, authorizes the designation of national marine sanctuaries to protect and manage areas of the marine environment that are of special national and (in some instances) international significance. Under the NMSA, NOAA's Sanctuaries and Reserves Division develops sanctuary-specific management plans to achieve comprehensive and coordinated conservation and management of resources, and to facilitate all

public and private uses of the resources in these marine areas, to the extent compatible with the primary purpose of resource protection.

Marine sanctuaries can protect and allow management of marine ecosystems. The NMSA requires inclusion of a resource assessment report, developed in consultation with other federal agencies where appropriate, in each environmental impact statement prepared for a sanctuary. The report documents present and potential uses of the area, including commercial and recreational fishing, research and education, minerals and energy development, subsistence uses, and other commercial, recreational, or governmental uses. The NMSA authorizes cooperative agreements to carry out its purposes, including agreements with non-profit organizations. By their nature, sanctuaries are limited geographic areas, in some cases large, in others small. Each management plan is tailored only to the specific area of the marine environment designated as a sanctuary. In order to protect resources within their boundaries, sanctuaries generally prohibit only a narrow range of activities. Therefore, the NMSA may not be sufficiently multiobjective or multipurpose to be used as a model for the ecosystem approach, although it may be a partner.

On November 16, 1990, in the Florida Keys National Marine Sanctuary and Protection Act, 16 U.S.C. § 1433 note, Congress designated the entire marine area around the Florida Keys as a National Marine Sanctuary. NOAA is currently developing a comprehensive management plan to address land-based water quality problems as well as physical threats to coral reefs and other sanctuary resources. The purpose of the Act is to protect sanctuary resources and facilitate multiple use of the sanctuary and its resources consistent with the resource protection mandate. NOAA's sanctuary program is working with the state of Florida, EPA, and other agencies to coordinate resources and efforts to manage the sanctuary and its resources.

National Estuary Program. Section 320 of the Clean Water Act establishes the National Estuary Program and requires, for 11 specified estuaries and others designated to participate in the program, the convening of a management conference (consisting of representatives from federal, state, tribal, and local entities as well as from industry, academia, and the general public) for the purpose of developing a comprehensive conservation and

management plan. Each plan is intended to recommend priority corrective actions and compliance schedules to address point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the particular estuary addressed. The management conference is also charged with developing plans for the coordinated implementation of the plan by state as well as federal and local agencies and to monitor the effectiveness of the actions taken pursuant to the plan. Section 320 also directs the management conference to review federal assistance and development projects for consistency with the comprehensive conservation and management plan.

National Coastal Monitoring Act. The National Coastal Monitoring Act (Title V of the Marine Protection, Research, and Sanctuaries Act) requires the U.S. Department of Commerce and EPA to jointly develop and implement a comprehensive program for consistent monitoring of the nation's coastal environments and ecosystems. The program is to do the following: include environmental assessments and intensive monitoring programs in selected coastal regions that are adversely impacted by pollution; issue national guidelines for field sampling and analytical procedures; recommend uniform indicators of coastal environmental quality and ecosystem health; specify protocols for data quality control and archiving in digital format; and establish a coastal environmental information system.

Authorities for specific geographic areas.

Statutes designed to protect or restore ecosystems in specific geographic areas provide opportunities for interagency collaboration in these areas. Such areas include Coastal Louisiana and the New Jersey Pinelands.

Coastal Louisiana. In 1990, the United States Congress passed the Coastal Wetland Planning, Protection, and Restoration Act (CWPPRA), 16 U.S.C. §§ 3951-3956. The Act created a partnership between the state of Louisiana and five federal agencies (the Corps, EPA, Fish and Wildlife Service, National Marine Fisheries Service, and Natural Resources Conservation Service) and established a six-member task force composed of one representative from each group. Charged with developing a "comprehensive approach to restore and prevent the loss of coastal wetlands in Louisiana," the task force is

responsible for developing and implementing priority coastal wetland restoration projects. The Act made tens of millions of dollars available for wetland restoration projects on a 75–25 percent cost share basis, with Louisiana's share derived from its Wetlands Trust Fund, established in 1989. The CWPPRA is the primary federal legal authority used in Coastal Louisiana as a vehicle for facilitating a broad-based approach to coastal wetland restoration. The CWPPRA mandate and institutional framework facilitate an interagency and intergovernmental approach to the problem of coastal wetlands loss in Louisiana. The CWPPRA framework serves as a valuable model and/or nucleus for any additional activities to implement the ecosystem approach. In April 1995, the state of Louisiana released a white paper review of its restoration policies and activities that recommends significant changes in project focus and administrative and funding mechanisms to ensure long-term restoration of the coast.

New Jersey Pinelands. State and federal legislation enacted to protect the New Jersey Pinelands has met with considerable success and is viewed by some as a national model for regional management and conservation (State of New Jersey Pinelands Commission 1989). In 1978, Congress created the Pinelands National Reserve, providing basic guidelines for governments at every level to follow in helping to shape the area's future. The state was to take the lead in evaluating the Pinelands' resources and in planning how best to balance their protection with new development. The law authorized establishment of the Pinelands Commission (consisting of state, county, and federal officials) to carry out these tasks.

In June 1979, the New Jersey Legislature supplemented the federal law by passing the Pinelands Protection Act. Among other things, the Act requires that county and municipal master plans and land use ordinances be brought into conformance with the Comprehensive Management Plan developed by the Pinelands Commission. The state law requires consideration of both economic and environmental factors, restricts development in "preservation" areas of relatively unbroken forest, and allows somewhat more development in other "protection" areas. The law allowed the Commission to divide protection areas regionally according to land use capability, and to prescribe land uses for each region, including forest, housing, agricultural production, regional growth, and rural

development. The Commission has the power to ensure that proposed development projects are consistent with the Comprehensive Management Plan.

The state law envisioned that local governments would be primarily responsible for implementing the Plan. To attain that degree of local involvement and responsibility, the Pinelands Protection Act set forth a procedure under which county and municipal master plans and land use ordinances would be made consistent with the Plan. Although some of the Plan's provisions are mandatory (such as density limitations and the requirement that growth areas accept development credits), many other aspects are intended to give municipalities resource management goals to work toward as they revise their land use regulations. The specific means chosen to meet those goals are open to negotiation between the Commission and local government.

Other Legal Mechanisms for Achieving an Ecosystem Orientation

Other legal mechanisms that can be used to promote an ecosystem approach to natural resource management include interagency coordination tools (such as Memoranda of Understanding), enforcement mechanisms, interagency technical assistance, funding for the ecosystem approach, place-based regulations, and information sharing.

Coordination Tools. Memoranda of Understanding and other interagency agreements provide tools for agencies to coordinate their activities without having to go through the regulatory or legislative process. They can be tailored to a particular region or project.

Pacific Northwest forests. To follow through on the President's Forest Plan, a cooperative framework that institutionalizes federal interagency coordination was established through formation of a Regional Interagency Executive Committee and provincial executive committees (see chapter on Pacific Northwest forests, volume 3, Interagency Ecosystem Management Task Force 1995). A Memorandum of Understanding established a regional interagency team as well as subregional (or province-level) teams. To supervise the monitoring process that is at the heart of the Forest Plan, the Memorandum establishes a policy-level Interagency Steering Committee and a Regional

Interagency Executive Committee consisting of regional representatives of the Bureau of Indian Affairs, Bureau of Land Management, EPA, Fish and Wildlife Service, Forest Service, and National Marine Fisheries Service. The Forest Plan also creates 12 "province analysis areas," each with its own interagency committee, to assure that monitoring will be coordinated across administrative boundaries.

In addition, to ensure an efficient, effective federal response to regional declines in salmon and steelhead populations, federal agencies signed a Memorandum of Understanding that establishes "a federal framework to facilitate the development and implementation of a coordinated and comprehensive conservation and restoration plan for Pacific salmon." The Memorandum of Understanding is intended to avoid unnecessary duplication of efforts within the federal government and to assist agency efforts to coordinate with nonfederal stakeholders.

South Florida. The South Florida Ecosystem Restoration Task Force, convened in June 1993 by the Department of the Interior and subsequently formalized in a Memorandum of Understanding, includes key Interior Department bureaus and representatives from the U.S. Departments of Justice and Agriculture, EPA, NOAA, and Corps. This policy-level group is charged with developing federal objectives for restoring the ecosystem as part of the Corps' Central and Southern Florida project, designing an ecosystem-based science program, supporting the development of multispecies recovery plans, and coordinating a variety of specific restoration projects. Its efforts are supported by a field-level working group that provides on-the-ground implementation assistance, project monitoring, and ongoing oversight.

Other interagency agreements. Under the Endangered Species Act (ESA), coordinated ecosystem approaches can be enhanced by interagency agreements. For example, the Fish and Wildlife Service and National Marine Fisheries Service recently agreed to a policy for enhancing state cooperation in activities pursuant to the ESA (Notice of Interagency Cooperative Policy Regarding the Role of State Agencies in Endangered Species Act Activities, 59 Fed. Reg. 34,274 (1994)). Under the ESA, federal agencies can work together toward ecosystem health even as it affects protected species. For example, in January

1994 the Fish and Wildlife Service, Forest Service, Bureau of Land Management, National Park Service, and National Marine Fisheries Service issued a Memorandum of Understanding to "establish a general framework for cooperation and participation among cooperators in the conservation of species that are tending toward federal listing as threatened or endangered" under the ESA. The Forest Service and the Fish and Wildlife Service quickly applied this Memorandum by signing a cooperative agreement to protect a rare species of salamander in the Shenandoah Mountains. The agreement was designed to stabilize and protect populations of the salamander so that it will never have to be listed as threatened or endangered.

Enforcement mechanisms. Mechanisms related to enforcement of environmental regulations can provide federal agencies with important means of coordinating efforts to implement the ecosystem approach. Such mechanisms include targeting ecologically sensitive areas for pollution control and facilitating Supplemental Environmental Projects.

Focusing enforcement and pollution control efforts. EPA and other agencies have begun to explore focusing enforcement and pollution control activities in priority ecosystems. For example, EPA has launched a project to use geographic targeting to focus pollution prevention and enforcement activities on the protection of ecologically important areas, such as national wildlife refuges, national parks, wilderness areas, Areas of Critical Environmental Concern designated by the Bureau of Land Management, Outstanding Natural Resource Waters, state-identified areas, and areas of local environmental concern.

EPA's project is developing geographic targeting capabilities, such as facility emission ranking and chemical hazard ranking, to help identify facilities for source reduction, technical assistance, multimedia inspections, and compliance activities. National-scale maps of pollution sources overlaid with regional ecosystems and watershed boundaries will provide an overview of contaminated hotspots across the country. Regional-scale maps will rank high-risk emission sources and portray their distribution in relation to sensitive areas. Local-scale maps will profile pollution sources that may be impacting specific sensitive areas. The project will combine two types of geographic-information-system activities that will be

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performed simultaneously—the production of maps and the development of computer applications for retrieving, formatting, and displaying information on ecological attributes and stressors. In exercising their considerable enforcement discretion, agencies could increase the use of such geographic targeting techniques to more efficiently and effectively further the overarching goals of the ecosystem approach, as well as specific objectives established at regional and local levels.

Supplemental Environmental Projects. A Supplemental Environmental Project (SEP) is defined by EPA as an environmentally beneficial project undertaken by a defendant in an EPA administrative or civil enforcement action. The defendant undertakes the project in exchange for favorable penalty consideration in settlement of the enforcement action. The project must be something that the defendant is not otherwise legally required to do; that is, it must go beyond compliance with the law and correction of the violation to provide a benefit to the environment or to the human population that was affected or put at risk by the violation. Under EPA policies, SEPs may be included in a settlement only if three conditions apply: (1) the violations at issue in the case are being (or have already been) corrected; (2) the defendant is paying a substantial monetary penalty; and (3) there is an appropriate nexus between the violation and the environmental benefits from the SEP. Seven categories of permissible SEPs are public health, pollution prevention, pollution reduction, environmental restoration and protection, assessments and audits, environmental compliance promotion, and emergency planning and preparedness.

SEPs provide a potentially useful tool for supporting efforts to implement the ecosystem approach. When evaluating proposed SEPs or suggesting possible SEPs to defendants, EPA personnel should ensure, to the extent practicable, that the projects are consistent with or complement any relevant efforts to implement the ecosystem approach. However, because the authority to perform SEPs is tied to the authority of the EPA Administrator and the Attorney General to compromise and settle individual cases and administrative matters, the process of reviewing and approving SEPs is of necessity conducted on a case-by-case basis. This means that EPA and the U.S. Department of Justice have somewhat limited flexibility in using

SEPs from multiple cases to support projects intended to address ecosystem priorities.

Interagency technical assistance. A concrete and necessary aspect of the ecosystem approach is agencies' sharing of expertise with other agencies.

Corps technical assistance. The Corps has substantial expertise in water resources, infrastructure planning and development, and environmental management and restoration. The Corps often assists other federal agencies, particularly EPA, the U.S. Department of State, and international organizations such as the United Nations, in addressing domestic or international natural resource and environmental problems. In addition, section 22 of the Water Resources and Development Act of 1974 authorizes the Corps to cooperate with any state, at its request, in the cost-shared preparation of comprehensive plans for water resources development, utilization, and conservation. However, organizations that request Corps assistance are often unable to reimburse all of the Corps' costs. In such instances, the Corps needs a clear source of funds for costs not covered by the requesting entity. Currently, it must approach Congress for funding, a way of doing business that is cumbersome and unpredictable.

Personnel details and exchanges. The Corps recently completed a "reconnaissance study" of the Central and Southern Florida Project. As part of this effort, the Corps hired federal employees on temporary duty to address specific issues. For example, in order to ensure that wildlife concerns were addressed at all phases, the Corps hired a Fish and Wildlife Service employee to work on the project full-time. Opportunities for productive personnel exchanges will likely increase with an increase in use of the ecosystem approach. However, the process has been made more difficult by recent amendments to the Internal Revenue Code. The Code now provides that any term of employment away from an employee's home that exceeds 1 year is deemed to be permanent, rather than temporary (26 U.S.C. § 162(a); Revenue ruling 93-86). Reimbursement for expenses (such as per diem payments) is thus considered taxable income for which the employee is liable, and expenses incurred during the period of employment are nondeductible. Because of this new rule, the Corps recently had to cut short an 18-month temporary duty assignment. Disincentives for federal

employees to participate in details or exchanges should be further analyzed and removed, if appropriate.

EPA National Environmental Policy Act assistance. Under section 309(a) of the Clean Air Act, 42 U.S.C. § 7609(a), EPA reviews and comments on other federal agency actions, including proposals for legislation, proposed regulations, and proposals subject to section 102(2)(C) of the National Environmental Policy Act (NEPA), which requires preparation of an environmental impact statement. Other agencies have a slightly narrower role of review and comment in the NEPA process (40 CFR Part 1504).

EPA and other agencies with environmental expertise could expand the technical and other assistance they provide in reviewing federal proposals by moving toward a more proactive approach that comprehensively considers principles and plans under the ecosystem approach. In coordination with other agencies, EPA could develop guidance for its NEPA reviewers to ensure that federal agencies do the following: systematically analyze the effects of proposed federal actions on biodiversity and ecosystem health; explore opportunities to support sustainable economies and communities; explore opportunities to coordinate with other federal agencies and the nonfederal community, on a collaborative basis, at the ecosystem scale; consider previously established federal or nonfederal ecosystem approach objectives; rely on sound ecological, social, and economic science; use benchmarks to monitor and evaluate outcomes, where appropriate; and analyze opportunities to utilize adaptive management approaches.

Funding for the ecosystem approach. Authorities to provide funding for the ecosystem approach help to lay the foundation for interagency work and coordination at the ecosystem level. Such authorities include statutes administered by EPA and challenge cost-share programs under the Department of the Interior.

EPA. Statutes administered by EPA contain a wide range of grant* authorities that could be used

immediately or adapted over time to support activities to implement the ecosystem approach. A limited number of statutory provisions specifically authorize EPA to award grants to support ecosystem- or place-based research and management. For example, Clean Water Act section 320(g) authorizes EPA to make grants covering up to 75 percent of the costs of developing conservation and management plans for estuaries under the National Estuary Program. In addition, EPA has broad grant authorities to support continuing environmental programs as well as research, development, training, and demonstrations (Clean Air Act §§ 103(b)(3) and 105; Clean Water Act §§ 104(b)(3), 105, 106, 109, 205(j)(2), and 319; Safe Drinking Water Act §§ 1442 and 1443(b); Resource Conservation and Recovery Act §§ 3011 and 8001(a); Federal Insecticide, Fungicide, and Rodenticide Act §§ 20 and 23; Toxic Substances Control Act §§ 10 and 28; and Comprehensive Environmental Response, Compensation, and Liability Act § 311). Although these grant authorities are generally restricted to single media (such as water or air), directed at pollution control, and limited in their ability to address socioeconomic sustainability issues, they can potentially be used to fund ecosystem-wide activities where there is a direct relationship between the funded activities and the purpose of the single-media authority. Furthermore, a single grant can be awarded using several of the research and demonstration authorities to support multimedia ecosystem studies.

EPA also has limited multimedia grant authorities that can be used to support efforts to implement the ecosystem approach. These include section 6605 of the Pollution Prevention Act (providing grants to states for programs to promote source reduction techniques by businesses), section 6 of the National Environmental Education Act (authorizing grants to design, demonstrate, or disseminate environmental education methods), and the National and Community Service Act (providing grants for service programs addressing established EPA priorities, 42 U.S.C. §§ 12501 *et seq.*). Finally, EPA has authority to include in its diverse grant awards "special conditions" requiring grantees to address concerns of the ecosystem approach where the conditions directly relate to the goals of the authorizing statute.

As with all federal grants, the primary purpose of EPA grants must be to support a public purpose

*The term "grant" as used in this analysis includes cooperative agreements as well as grants. Both are financial assistance agreements; they differ only in the extent of EPA involvement in the project.

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authorized by statute, and not to acquire goods and services for the government. Contracts must be used to acquire such goods and services.

In addition to making grants, EPA has authority to award contracts for services, such as ecosystem-related assessments or research that is consistent with its statutory objectives. EPA may also enter into agreements to share in the cost of ecosystem projects with other federal agencies in order to obtain goods or services from them. Such interagency agreements are authorized by the Economy Act, 31 U.S.C. § 1535, and by provisions of EPA's media statutes authorizing cooperation with other federal agencies (such as Clean Water Act § 104(b), Clean Air Act § 103(b), and Resource Conservation and Recovery Act § 6003).

Department of the Interior: Challenge cost-share programs. Various agencies within the Department of the Interior promote partnership arrangements designed to aid them in managing resources and in obtaining voluntary contributions of services, money, materials, labor, and other expertise. The Department's challenge cost-share programs exemplify how partnership arrangements can assist management efforts. The Fish and Wildlife Service administers one challenge cost-share program designed to manage, enhance, and restore fish and wildlife resources and to support wildlife-oriented education programs on lands it manages. For example, this program has facilitated restoration of tallgrass prairie and wetlands. Similarly, the Bureau of Land Management has developed several challenge-cost share opportunities to implement various recreation and resource management programs, such as its Cultural Heritage programs. The National Park Service also participates in challenge-cost share programs, with projects for historical and archeological site restoration, resources inventory and monitoring projects, resources management restoration projects, scientific surveys, rails-to-trails conversion opportunities, and interpretive and educational programs.

Place-based regulations and delegations of authority. The U.S. Coast Guard's Field Regulations provide a possible model for a place-based approach to regulatory activity. The Coast Guard is charged with controlling and managing vessel traffic to ensure the safety and security of ports and waterways of the United States. Many of the issues that arise in doing so are local in origin: each port presents unique waterways management

issues, and attempting to regulate all ports using a single set of regulations would not be efficient, responsive, or economical. The Coast Guard has delegated appropriate authority to local field commanders to issue regulations and orders to assist in managing the waterway system.

Under the Ports and Waterways Safety Act, 33 U.S.C. §§ 1221–1232, authority to control vessel traffic in certain areas was delegated to local field commanders. In order to implement this authority, the local field commanders may issue direct orders to individual vessels, establish safety zones by regulation (which limit entry of vessels to specific areas for safety and environmental purposes, usually on an emergency basis), or establish navigation areas (which set permanent limitations in order to preserve the safety of adjacent waterway structures, ensure safe transit of vessels, or protect the marine environment). The statute also mandates that, at the earliest possible time, the Coast Guard must consult with and consider the views of the maritime community, ports and harbor authorities or associations, environmental groups, and other parties who may be affected by the proposed actions.

Delegation of authority to local federal officials to deal with local or regional environmental issues would in many cases permit a more flexible, focused approach to issues. A disadvantage of this approach is that it would require a certain level of expertise in field units in order to comply with the National Environmental Policy Act, Coastal Zone Management Act, and other nationally applicable statutes. Some agencies do not currently allocate resources on a local level to develop this type of expertise.

Short of fully delegating rulemaking authority, agencies could (where appropriate and consistent with existing law) seek either to tailor regulations to local or regional ecological and socioeconomic conditions up front, or to build flexibility into national regulations so that they could be readily applied at the local or regional scale. For example, instead of a single, national numeric criterion for a pollutant, a permissible range of pollutants could be established by rule (or policy or guideline), in anticipation that this rule would be implemented only after review of local circumstances. Similarly, agencies could ensure that rules are based upon, or allow consideration of, the full range of ecological and socioeconomic factors

in order to allow for flexible application. Finally, to ensure that national rules are functional at local and regional ecosystem scales, agencies could routinely solicit comment from ongoing efforts to implement the ecosystem approach.

A similar "tool" for promoting effective federal participation in efforts to implement the ecosystem approach is ensuring that delegation of decision-making authority rests with federal employees directly involved in ecosystem approach initiatives. The ability to award grants or other assistance in a reliable and timely fashion, for example, may be critical to the success of early federal involvement. For similar reasons, the Bureau of Land Management's Idaho Field Ecosystem-Based Management Strategy increased delegations from state office down to the district and resource area offices to place more capability and accountability close to on-the-ground management activities. To date, the Bureau reports increased productivity and efficiency within its field offices, as well as improved customer service.

Information sharing: Freedom of Information Act and proprietary data. Information sharing is crucial to the ecosystem approach; important aspects of this issue are discussed in the chapter on Science and Information in this volume. One legal barrier may be the Freedom of Information Act (FOIA), 5 U.S.C. § 552, which provides that any person has a right, enforceable in court, to see federal agency records, except to the extent that those records are specifically protected from disclosure by FOIA's nine exemptions or three law enforcement record exclusions. The FOIA exempts from disclosure inter- and intra-agency memoranda and other documents that are part of a government deliberative process (5 U.S.C. § 552(b)(5)). However, this exemption is generally inapplicable in protecting purely factual information or factual portions of otherwise deliberative documents.

The FOIA can be a significant barrier to the collection of information about the location of species that require strict protection by federal land managers and by such federal agencies as the National Biological Service and Fish and Wildlife Service. Depending on how it is used, such information may be considered purely factual and therefore unprotected from public disclosure under the FOIA. The National Park Service, for example, may not be able to protect information about the location of wild ginseng root, a lucrative and widely poached

plant that inhabits Great Smoky Mountains National Park. The National Biological Service has found that private landowners such as timber companies are reluctant to allow it to survey their lands because public access to the information obtained may lead to trespassing to take species. Moreover, data shared with or among government scientists could be appropriated for use by outside scientists before the originating scientist can publish his or her findings for professional credit. Among scientists, the sharing of data is a trust exercise that can be upset by even the threat of public disclosure.

Another example of this problem, identified in the Great Lakes survey team study, concerns the Natural Heritage program established by The Nature Conservancy in partnership with state and provincial governments. This program brings together various inventories of biological resources, supplements it with additional surveys, and then analyzes the data. If this data is passed to EPA, it may be subject to public disclosure under the FOIA and could then be used by developers and others to alter environmentally sensitive areas in advance of any development activity requiring state and/or federal approval.

Legislative action may be required to effectively address this problem. Exemption 3 of the FOIA exempts from disclosure factual or other information that must be withheld under another statute (5 U.S.C. § 552(b)(3)). A model for such legislation can be found in the Archeological Resources Protection Act, 16 U.S.C. §§ 470aa *et seq.* This Act requires federal land managers to withhold information concerning the nature and location of archeological resources, unless that information is needed to protect a site from destruction or the disclosure would not create a risk of harm to the resources (16 U.S.C. § 470hh).

PARTNERSHIPS WITH PRIVATE LANDOWNERS

An ecosystem approach to management requires that federal agencies pay close attention to the needs of private landowners and seek their voluntary participation in collaborative efforts. Federal activities must be predictable, their effects on private lands foreseeable, and federal regulations straightforward. A variety of federal laws and agency programs facilitate these goals. First, there are federal laws that provide for financial and

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technical assistance to private landowners. Second, some laws and agency policies allow for agreements between landowners and federal agencies in which landowners ensure that environmental goals are met in exchange for certain benefits. Third, federal agencies are beginning to institute policies to assure private landowners that federal requirements will retain a significant degree of predictability.

It is important to stress that the ecosystem approach does not increase the government's authority under the regulatory programs it administers. Instead, the ecosystem approach should result in less contentious decisions and more predictability. The ecosystem approach emphasizes cooperative problem solving and is being implemented in a manner that fully respects property rights while enhancing the government's and communities' ability to protect human health and the environment.

Assistance and Incentives for Private Landowners

Various statutes authorize federal agencies to provide assistance to private landowners and incentives for them to participate in the ecosystem approach. Agencies provide assistance in conserving natural resources, preserving wetlands, and managing forestlands.

Natural Resources Conservation Service programs. The Natural Resources Conservation Service has multiple program authorities and responsibilities, including watershed planning and implementation, resource inventory, and assistance to private landowners for resource protection and enhancement. Providing conservation planning as well as technical and financial assistance to private landowners to achieve conservation objectives has been the primary focus of the agency. Authority for this function was granted in the Soil Conservation Service Act of 1935 (P.L. 74-46) as amended, which established the agency (formerly Soil Conservation Service).

Over the years, Congress has added a number of programs and broadened the authority and mission of the Natural Resources Conservation Service to provide an increasingly multifaceted approach to conservation and environmental enhancement. The agency administers designated programs and

provides technical assistance to a growing list of state and federal programs.

Specific authorities for providing direct conservation assistance to private landowners are the Soil Conservation Act, Watershed Protection and Flood Prevention Act (16 U.S.C. §§ 1006-1009), and P.L. 84-1021, which establishes the Great Plains Conservation Program. The Natural Resources Conservation Service administers both P.L. 566 and P.L. 84-1021, which provide cost-share assistance as well as technical and planning assistance to private landowners to carry out conservation treatment specified in long-term contracts.

The P.L. 566 watershed program provides technical and financial assistance to local sponsors to develop and implement plans for watershed protection, flood prevention, agricultural and nonagricultural water management, and ground water recharge. Through its Watershed and Flood Prevention Loan Program, the Farm Services Agency has helped local sponsors in the past to provide the local share of costs (not to exceed \$10 million in any watershed) for drainage, and it continues to offer funds for watershed protection works, such as flood prevention and irrigation. The P.L. 566 program bridges the gap between onfarm conservation practices by individual landowners and large projects on major rivers by the Corps and Bureau of Reclamation. The Corps is chiefly responsible for large-scale projects, whereas the Natural Resources Conservation Service gives technical assistance and provides cost-sharing programs for watersheds of 250,000 acres or less. This type of program ensures that private landowners maintain control over activities on their lands, and are consequently willing to engage in practices to assure sustainability of natural resources.

Incentives to protect fragile lands and preserve wetlands. The Conservation Reserve Program (CRP), authorized by the 1985 Food Security Act (the 1985 Farm Bill), offers rental payments and cost-share assistance to establish vegetative cover on cropland that is highly erodible or contributing to a serious water quality problem. No crops are produced on CRP lands, which are protective reserves. In the 8 years since its inception, the program has protected, at least temporarily, 36.4 million highly erodible acres and other sensitive lands.

The future of the CRP and of the environmental benefits gained by the program are in question because of uncertain funding to maintain or expand enrolled acreages beyond current contracts. As initial CRP contracts begin to expire in late 1995, farmers can bring that land back into production. The results of a 1993 survey by the Soil and Water Conservation Society show that participants intend to return a large percentage of their CRP acres to crop production after contracts expire.

The Wetlands Reserve Program is among the newest USDA conservation efforts. Authorized by the 1990 Farm Bill, the Wetlands Reserve Program began in 1993 as a pilot program similar to the CRP, with initial funding of \$46 million to enroll a maximum of 50,000 acres. Because it offers an optional land use for difficult-to-farm wet areas (restoring them to wetlands), the program is popular with farmers. The first enrollment occurred in 1992, with bids coming in from farmers who wanted to enter their wetlands at five times the number of acres that could be accepted.

Forest programs. Federal law provides for a number of cooperative forestry assistance programs, which could all be reviewed for opportunities and barriers to the ecosystem approach. They include:

- **The Forest Stewardship Program.** This program provides technical assistance to nonindustrial landowners (delivered through state forestry agencies) to develop integrated forest stewardship plans that meet individual landowner objectives. All resources are recognized and considered.
- **The Stewardship Incentive Program.** This program (also delivered through state foresters) provides cost-share funds (up to 75 percent) for on-the-ground approved practices that tier off the Forest Stewardship Plan for each landowner. Nine practices are approved nationally, including reforestation, stream enhancement, wildlife improvement, agroforestry efforts, and recreation opportunities.
- **The Forest Legacy Program.** This program provides for protection of environmentally important forest areas that are threatened by conversion to nonforest uses, and for promoting forest land protection and other

conservation opportunities through conservation easements and other mechanisms. The program provides a mechanism for preserving important forest areas and for cooperating with state, regional, and other units of government that could support consistent efforts.

- **The Cooperative Forestry Assistance Act.** The Cooperative Forestry Assistance Act of 1978 (as amended by the 1990 Farm Bill—the Food, Agriculture, Conservation, and Trade Act of 1990) gives the Forest Service authority to offer financial and technical assistance to 50 state forestry agencies and 4 territories to promote effective forestry practices on state and nonindustrial private lands. Assistance ranges from nursery and reforestation assistance to forest management and urban forestry.
- **Economic Action Programs.** A variety of Economic Action Programs help rural communities build social capital in locally developed, needs-driven efforts. Many timber-dependent communities are being helped to diversify their economies in ways that sustain the social fabric of the community while strengthening economies and conserving environments.

Endangered Species Act policies. The Departments of the Interior and Commerce recently announced separate or joint policies to:

- Allow land use activities by landowners that result in incidental take and that individually or cumulatively have negligible adverse effects on species, including: activities on tracts of land of 5 acres or less occupied by a single household and used solely for residential purposes; one-time activities that affect 5 acres of land or less of contiguous property, if that property was acquired prior to the date of proposed listing; and activities that are identified as negligible.
- Facilitate economic use of private land by placing additional federal lands in protection, by acquiring military lands when bases are closed, by enrolling existing federal lands in habitat reserves, and by arranging for purchases of Resolution Trust Corporation lands.

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- Provide incentives to landowners who voluntarily agree to enhance the habitat on their lands by insulating them from restrictions if they later need to bring their land back to its previous condition.

Tax incentives. The Internal Revenue Code contains several incentives to encourage conservation of private land, including tax incentives for:

- “Gifts” to public charities, resulting in income tax deduction and reduction of total estate for estate tax purposes. Landowners can give gifts of entire interest in land, conservation easements, and remainder interests.
- “Tax free exchanges” for like-kind property.
- Installment sales.
- Bargain sales.

Other tools. A variety of other approaches exist to voluntarily induce landowners to conserve their property, including: land leases, licenses, and management agreements with conservation organizations; conservation easements and other less-than-fee acquisitions; and dedications. Conservation easements are increasingly popular, because they allow conservation entities to preserve indefinitely natural resources on private property without having to acquire full title.

Agreements With Private Landowners

Statutes authorize federal agencies to enter into agreements with nonfederal landowners to protect sensitive habitats and to offset habitat losses. Such agreements are integrated into Habitat Conservation Plans and wetlands mitigation banking arrangements.

Endangered Species Act—Habitat Conservation Plans. Section 10(a) of the Endangered Species Act (ESA), 16 U.S.C. § 1539, authorizes the Secretary of the Interior to enter into conservation agreements with private landowners under which the Secretary permits “incidental takes” of listed species and landowners agree to develop long-term, private conservation programs to protect listed species. These Habitat Conservation Plans (HCPs) generally contain four documents:

- (1) a “planning document;” (2) a contract implementing the agreement; (3) an environmental assessment or environmental impact statement under the National Environmental Policy Act; and (4) an ESA section 10 incidental-take permit.*

Following issuance of the President’s Forest Plan in the Pacific Northwest, private and state landowners there have shown a strong interest in becoming parties to HCPs. The Fish and Wildlife Service has worked closely with these landowners to develop a number of agreements. Three agreements have been made with timber industry landowners in California, Oregon, and Washington, and a large number of additional agreements are being prepared with other timber companies in the Pacific Northwest. Federal officials have found that the HCP process promotes ecosystem integrity, allowing private and government scientists to join forces to gather necessary scientific data. Like the agencies, scientists have taken a multispecies approach to assessing conservation options.

Large-scale, regional HCPs hold considerable promise as mechanisms for bringing together stakeholders to plan and craft innovative solutions at a regional ecosystem level. Regional HCPs involve multiple property owners, government units, and species. Their preparation is usually overseen by steering committees made up of representatives of the major stakeholder groups in the community, and often chaired by a neutral party such as The Nature Conservancy (Beatley 1994, p. 20). This opportunity for collaboration under the ESA should be more fully utilized. The more the HCP development process includes diverse stakeholders, increases ecosystem integrity, and accounts for socioeconomic factors, the more it can be viewed as a ready framework for the ecosystem approach. However, HCPs are only relevant where one or more species are already in serious decline, and delaying cooperative efforts until species are at risk limits management options. Proactive efforts are needed to maintain ecosystem integrity and promote sustainable economies before species decline.

*The incidental-take permit gives landowners immunity from prosecution if a member of a threatened or endangered species is incidentally killed or harmed during construction or land use activities in accordance with the HCP.

Wetlands mitigation banking. Wetlands mitigation banking involves the restoration, creation, preservation, or enhancement of wetlands expressly to offset destruction or deterioration of wetlands due to future activities (such as development). Credit for performing these environmentally beneficial actions is stored in a wetlands "bank" until needed. "Credits" can be withdrawn from the bank to satisfy the wetland mitigation requirements of a federal, state, or local regulatory agency.

There are essentially two types of mitigation banks: single-user banks, which are established and used for mitigation purposes by a specific organization (such as a state department of transportation); and general-use banks, which are developed to make credits available to a variety of potential "debtors," that is, permit applicants who may be allowed to obtain mitigation "credits" to satisfy compensatory mitigation requirements. This latter category includes mitigation banks created by private entrepreneurs for the purpose of making a profit from the sale of credits.

The environmental benefits of wetlands mitigation banking include:

- Advancing the goal of no net wetlands loss, and avoiding the temporal loss of wetland functions.
- Providing larger restored or created wetlands that are more ecologically valuable.
- Providing more confidence that mitigation required under a permit will be accomplished and will work as planned.
- Allowing more ecologically beneficial locations for mitigation.
- Demonstrating to the public that environmental protection through regulation does not necessarily prohibit economic development.

Benefits to private landowners from mitigation banking include:

- Streamlining permitting and reducing permit review time by providing greater certainty that mitigation will be acceptable.

- Offering the regulated community less expensive mitigation options (one large mitigation project is most likely less expensive than numerous small ones).
- Enhancing planning predictability and flexibility for developers by offering them the opportunity to either develop their own wetlands mitigation bank or plan to purchase credits from another bank.
- Demonstrating to the public that economic development is not necessarily inconsistent with environmental protection.

To facilitate the development of appropriate mitigation banking arrangements, the Corps, EPA, and other federal resource agencies recently released draft joint guidance on mitigation banking, to be finalized soon.

Development Credits. Acting pursuant to state and federal laws protecting the New Jersey Pinelands, the Pinelands Commission created "Pinelands Development Credits" to address the competing concerns of rising land values in some areas and the need to limit development in other, more environmentally sensitive areas. The program works by allocating development credits to landowners in certain areas where growth is limited. The credits can be purchased by developers who own land in growth areas and used to increase the densities at which they can build. A landowner selling credits retains title to the land and is allowed to continue using it for any nonresidential use authorized by the comprehensive Pinelands plan. Credits are sold on an open market in the Pinelands Development Credit Bank.

Assuring Predictability and Ease of Compliance

Federal agencies are increasingly implementing policies to make federal activities predictable and their effects on private lands foreseeable. In addition, federal agencies are taking measures to facilitate compliance by private landowners with federal regulations.

Endangered Species Act "4(d) rules." The Department of the Interior has published several special rules under the Endangered Species Act (ESA) that allow development of private lands to

proceed and still protect threatened species. A special 4(d) rule developed for the coastal California gnatcatcher avoids the creation of a separate set of federal ESA requirements by incorporating by reference the results of a state planning process, because this process will conserve the gnatcatcher and all other species that depend on the same habitat, and will allow residential development to continue. In the states of Washington and California, the Interior Department has proposed a 4(d) rule that will generally exempt landowners with less than 80 acres of forest land from the Act's prohibition on incidental take of spotted owls. In addition, the proposed rule would significantly scale back the level of federal restrictions on more than 5 million acres of nonfederal land in Washington and California.

Minimizing social and economic impacts. A recent Interior Department policy directive on recovery planning requires that any social or economic impacts resulting from implementation of recovery plans be minimized.

Habitat Conservation Planning Handbook. The Fish and Wildlife Service and National Marine Fisheries Service have published a draft habitat conservation planning handbook that is intended to streamline the HCP process and provide quicker and more consistent answers to applicants for incidental take permits.

ESA "no-surprises" policy. The Fish and Wildlife Service and National Marine Fisheries Service are currently promoting Habitat Conservation Plans (HCPs) as an exemption from the take prohibition otherwise applicable under the ESA. The HCP process recognizes that permits of 30 years or more may be necessary to trigger long-term private sector funding and land use commitments for species and ecosystem conservation. In addition, on August 11, 1994, the Departments of Commerce and the Interior declared a policy that will give more long-term economic certainty to landowners who negotiate HCPs. Under this "no-surprises" policy, landowners who obtain approval of an HCP under section 10 of the ESA will not be subject to later demands for a larger land or financial commitment, even if the needs of species are found to have changed over time. If additional mitigation measures become necessary for the conservation of a species protected under an existing HCP, the wildlife agency will have to show that the additional measures are required by

extraordinary circumstances and that they do not require compensation or apply to land that was available for development under the HCP. This "no-surprises" approach can be utilized to ensure the predictability needed by key stakeholders where efforts to implement the ecosystem approach face endangered species concerns.

ESA section 9 policy. The recently established Interagency Cooperative Policy for ESA section 9 prohibitions is designed to provide landowners with as much certainty as possible regarding prohibitions against "taking" listed species under section 9 of the Act. Under the policy, the National Marine Fisheries Service and Fish and Wildlife Service will identify, to the extent known at the time a species is listed, specific activities that are and are not considered likely to result in a violation of section 9. For activities where it is uncertain whether a violation is likely, a contact will be identified in the final listing document to assist the public in determining whether a particular activity would be prohibited under section 9. The ecosystem approach could serve as an efficient vehicle for further disseminating this information.

Consolidation of permitting. The regulated community faces an array of federal, state, and local regulatory processes and permitting requirements, including those pertaining to wetlands, floodplains, endangered species, air emissions, wastewater discharges, and waste storage and disposal. It is often time-consuming for a permittee to find out which permits are required for a given activity; which federal, state, or local agencies issue the permits; and which information and documents must be available and/or filed in order to obtain the permits. In addition, industrial sources often remedy the problems in one pollutant medium by increasing pollutant releases into another, and agencies may take inconsistent approaches to the same ecological or socioeconomic concerns. One way to address these issues is through "one-stop permitting," which consolidates the permitting process, thereby reducing the number of permits required and agencies to be dealt with. Several states have discussed or implemented proposals for one-stop permitting, including California, Kansas, Massachusetts, New Jersey, Virginia, and Washington.

Alaska and California have established statewide public information centers to provide planners and developers with all necessary information on

federal and state permits. New Jersey has established the Office of Permit, Information, and Assistance, which helps new businesses and businesses that are expanding their facilities obtain necessary permits. Administrators run a preapplication screening process to identify potential problems with a project, and also follow up on the permits once the application has been submitted. This process reduces the amount of time necessary to get full permitting, because the system is integrated to require only one public hearing for all emissions.

COMMUNICATING AND WORKING WITH STAKEHOLDERS

Numerous federal statutes, including the National Environmental Policy Act, National Forest Management Act, Federal Land Policy and Management Act, and the Administrative Procedure Act, make public participation in federal decision-making processes mandatory. Although administrative procedures are in place under these statutes to allow for public input into many federal and state environmental and land management decisions, agency officials often fail to establish the type of interactions with and between community members that leads to the consensus-building sought under the ecosystem approach. There is a tendency for officials to accept input, but not to encourage the constructive dialogue that can lead to collaborative solutions.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) process encourages the involvement of interested and affected stakeholders. Regulations issued by the Council on Environmental Quality require that federal agencies "to the fullest extent possible . . . [e]ncourage and facilitate public involvement in decisions which affect the quality of the human environment" (40 CFR § 1500.2). Agencies must allow opportunities for public comment at both the draft and final stages of preparing an environmental impact statement; substantive comments received at the draft stage must be addressed in the final environmental impact statement. The Council on Environmental Quality's regulations also require that as part of the "scoping" process for an environmental impact statement, the lead agency shall "[i]nvite the participation of affected Federal, State and local agencies, and any

affected Indian tribe, the proponent of the action, and other interested persons (including those who might not be in accord with the action on environmental grounds)" (40 CFR § 1501.7). Public hearings or meetings are also called for when appropriate (40 CFR § 1506.6c). In addition, agencies' environmental impact statements must contain a discussion of "inconsistencies of their proposed actions with State or local plans and laws" (40 CFR § 1506.2(d)).

However, as currently implemented, public notice and comment under NEPA are often not conducive to the kind of collaboration and consensus-building with stakeholders that is essential to the ecosystem approach. Beyond scoping and soliciting public comment, the ecosystem approach seeks to bring stakeholders together to develop a shared vision for an ecosystem, to recognize problems as common to all, to look beyond the stereotypes and false impressions that can divide stakeholders, to engage in joint data collection and analysis, and to arrive at creative and innovative solutions to issues at the ecosystem level. One way the NEPA process could help achieve these ends would be through voluntary interagency ecosystem approach environmental impact statements. Similarly, Council on Environmental Quality guidance or regulatory revisions could be developed with a view to making the NEPA process more supportive of active and collaborative stakeholder involvement, both where agencies act individually and where they plan together.

Federal Advisory Committee Act

The Federal Advisory Committee Act (FACA), 5 U.S.C. App. 2, imposes procedural requirements on federal agencies in certain circumstances when they solicit and receive collective advice from persons who are not full-time federal employees. The Act, and the executive branch regulations and policies designed to implement it, have proven to be an impediment to the ecosystem approach.

Background. Congress passed FACA in 1972 to control the growth and operation of the "numerous committees, boards, commissions, councils, and similar groups which have been established to advise officers and agencies in the executive branch" (5 U.S.C. App. 2 § 2(a)). The purpose of FACA was to eliminate unnecessary advisory committees, limit the formation of new

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committees to the minimum number necessary, keep the function of the committees advisory in nature, and hold the committees to uniform standards and procedures (see *id.* §§ 2(b)(1)–(6)).

The FACA places a number of restrictions on the advisory committees themselves. If a group constitutes an “advisory committee” for purposes of FACA, the federal agency soliciting advice generally must, among other things, organize the committee under a charter, ensure that the committee’s membership is “balanced,” and provide for public notice of, and public participation in, the committee’s meetings. Transcripts of the meetings and copies of all documents considered by the committee generally must be made available to the public (for a description of FACA, see *Ass’n of American Physicians and Surgeons v. Clinton*, 997 F. 2d 898, 903 (D.C. Cir. 1993)).

Regulations and Administration policies. The General Services Administration has published regulations setting minimum requirements for and providing guidance to agencies in establishing, operating, and administering advisory committees subject to FACA (General Service Administration Regulations, 41 CFR Subpart 101–6.10). Among other things, these regulations provide for General Services Administration review of all proposed advisory committee charters (41 CFR § 101–6.1007).

In addition, the Clinton administration has imposed stringent limitations on the creation and use of FACA advisory committees. Executive Order 12838 (Feb. 10, 1993) directs each executive department and agency to terminate at least one-third of its advisory committees subject to FACA. The Order also prohibits creation or sponsorship of new advisory committees subject to FACA, except under the following circumstances: (1) where it is required by statute; or (2) where an agency head finds that “compelling considerations necessitate creation” of a committee, but only if the Director of the Office of Management and Budget (OMB) then approves the committee, and OMB approval is to be granted “only sparingly and only if compelled by considerations of national security, health or safety, or similar national interests.” The Administration also has announced a policy of opposing legislative language that “establishes new advisory committees or seeks to exempt groups from the requirements of the Federal Advisory Committee Act” (Gore 1994).

Litigation. In recent years, federal agencies have been sued for alleged FACA violations in a variety of contexts involving the management of natural resources. Many of these cases involve a claim that a federal agency has consulted with nonfederal advisors without following FACA procedures. For example, in *Northwest Forest Resource Council v. Espy*, 846 F. Supp. 1009 (D.D.C. 1994), a judge agreed with the timber industry that the federal government had violated FACA in developing the President’s Forest Plan for the Pacific Northwest by considering advice provided by the Forest Ecosystem Management Assessment Team, a group that included nonfederal scientists. In another case related to the issue of salmon protection in the Columbia River, industry representatives alleged that meetings between federal officials and representatives from states and tribes to settle an ongoing Endangered Species Act lawsuit and to discuss federal agency compliance with the Endangered Species Act were in violation of FACA. The district court held that FACA does not apply because the meetings were part of a court-ordered process to reconsider the federal agency decisions affecting hydropower operations (*Aluminum Company of America v. National Marine Fisheries Service*, No. 94–698–MA (D. Or.), December 7, 1994).

The courts have split on what legal remedies should be available to litigants who prevail against the government on FACA claims. In *Public Citizen v. National Advisory Committee*, 886 F. 2d 419 (D.C. Cir. 1989), the court declined to enjoin federal decision makers from considering advice obtained in violation of FACA; but in *Alabama-Tombigbee Rivers Coalition v. Department of the Interior*, 26 F. 3d 1103 (11th Cir. 1994), the federal government was permanently enjoined from using an advisory report on the Alabama sturgeon prepared in violation of FACA.

Impacts on the ecosystem approach. A central goal of the ecosystem approach is to foster stakeholder participation and to improve coordination between federal, state, and local decision makers. Moreover, the ecosystem approach frequently requires federal decision makers to obtain scientific and other advice from those outside the federal government. For these reasons, the issue of FACA compliance is likely to arise with growing frequency as federal managers adopt an ecosystem approach.

In most survey team studies, FACA was identified as the major impediment to adopting an ecosystem approach. Interviewees reported that:

- Citizens' groups, even those already established, do not meet because of confusion over FACA requirements (see chapter on Coastal Louisiana in volume 3 of this series, Interagency Ecosystem Management Task Force 1995). Even where the government is willing to charter a FACA group, some citizens are reluctant to sit on a group that is labeled "federal" (see chapter on Pacific Northwest forests, volume 3, Interagency Ecosystem Management Task Force 1995).
- Agencies resist forming groups that are necessary for planning, especially in the scientific area, because the burden of complying with FACA is greater than the benefit gained (see chapter on Southern Appalachians, volume 3, Interagency Ecosystem Management Task Force 1995).

Many interviewees recommended adding an exemption to FACA for federal-state or federal-tribal communications and meetings. Some tribal representatives maintained that federal-tribal meetings are already exempt from FACA (see chapter on Pacific Northwest forests, volume 3, Interagency Ecosystem Management Task Force 1995). In many areas, including South Florida, state and federal officials asserted that it is critical for them to have ongoing contacts, which FACA disrupts. Some state officials feel that they are left out of federal decision making due to FACA (see chapter on Prince William Sound, volume 3, Interagency Ecosystem Management Task Force 1995).

Stakeholders in other areas share these concerns. For example, the Western Governors' Association adopted a resolution at its June 1994 meeting stating that application of FACA to the states "hinders the free flow of communication between jurisdictions" and interferes with decision making. The resolution supports federal legislation that would, among other things, "exempt committees composed of full-time officers or employees of state government acting in their official capacities who are directed by statute to meet with federal officials and employees regarding programs that are shared by federal, state and local or which are administered by state governments or delegated by

the states to local governments" (Resolution 94-001, Western Governors' Association). Significantly, the resolution applies generally to federal-state coordination; it is not limited to resource management issues.*

Addressing the issue under current statutes and regulations. There are many situations where contact between federal agency personnel and outsiders is *not* subject to FACA. Agency personnel should understand when FACA applies and when it does not. Where contact between federal personnel and outsiders is not subject to FACA, it should be used appropriately to pursue ecosystem goals. Where FACA does apply, informed management and planning can minimize the burdens of FACA compliance.

Contacts not subject to FACA. The FACA does not apply to all contacts between federal personnel and outsiders (see *Public Citizen v. United States Department of Justice*, 491 U.S. 440, 453 (1989)). Agency personnel should fully understand the types of contacts that are not subject to FACA, and should not let "fear of FACA" inhibit lawful contacts with outsiders. The General Service Administration (GSA) Regulations (41 CFR Subpart 101-6.10) identify several examples of contacts between federal employees and outsiders that are not subject to FACA, and courts have recognized additional types.

Outside groups. Interested nonfederal parties can attempt to influence the federal government's decision-making processes by meeting with federal officials to provide their views. When the outside party is not a group "established" or formed by the federal government, the meeting is not subject to FACA, provided the federal government is not "utilizing" the group as an advisory committee. The GSA Regulations define a "utilized" committee as a group used by the agency as a "preferred source [of] . . . advice or recommendations" (41 CFR 101-6.1003).

* More narrowly focused, but in the same vein, is a resolution adopted in September 1994 by the International Association of Fish and Wildlife Agencies. The resolution supports legislation to "exempt from the Federal Advisory Committee Act all government entities with concurrent jurisdiction over fish and wildlife resources." Among other things, the resolution identifies FACA as a bar to participation by state biologists on forest plan interdisciplinary teams.

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At one time, courts followed GSA's approach to the definition of "utilized," holding that FACA applies when a federal agency uses an outside group as a preferred source of consensus advice. However, in *Public Citizen*, the Supreme Court's first FACA opinion, the Court declined to follow GSA's definition of "utilized" and held that the Department of Justice's routine solicitation of advice and recommendations from the American Bar Association regarding prospective judicial nominees was not subject to FACA. In reviewing the legislative history of FACA, the Court concluded that the phrase "utilized" means a group organized by a nongovernmental organization that is so closely tied to an agency as to be under agency control.

Among the factors a court may consider in determining whether a group is so closely tied to the government as to be "utilized" for FACA purposes are whether it receives funds from the government, whether such funds were intended for the specific purpose of creating an advisory committee, whether government employees regularly attend the group's meetings, whether government employees control or influence the group's agenda, and whether the government solicits the group's advice. However, in the absence of significant federal control and use of federal funds, citizens' groups and other organizations established outside the federal government can provide advice to federal agencies without violating FACA.

Committees that perform operational functions. The FACA defines the term "advisory committee" as a group that provides "advice or recommendations" (5 U.S.C. App. 2 § 3(2)). By direct implication, committees that do not provide advice or recommendations are not subject to FACA. Committees that perform "operational functions" are one example of such "nonadvisory" committees.* The GSA Regulations define "operational functions" as "those specifically provided by law, such as making or implementing Government decisions or policy" (41 CFR § 101-6.1004(g)). For example, in *Natural Resources Defense Counsel v. EPA*, 806 F. Supp. at 276, the court relied on the "operational functions" distinction in rejecting the Natural

Resources Defense Counsel's claim that a "Governors' Forum" created by EPA was subject to FACA.

Committees that provide information. Committees whose function is the exchange of information rather than the provision of advice also fall outside FACA's definition of advisory committee. The GSA Regulations provide that "any meeting . . . for the purpose of exchanging facts or information" is not subject to FACA (41 CFR § 101-6.1004(k)(1)).

Advice from individuals. The GSA Regulations state that advice provided by an individual is not subject to FACA (see 41 CFR § 101-6-1004(h)). The Regulations also provide that "[a]ny meeting initiated by a Federal official(s) with more than one individual for the purpose of obtaining the advice of individual attendees and not for purposes of utilizing the group to obtain consensus advice or recommendations [is not covered by FACA]. However, agencies should be aware that such a group would be covered by the Act when an agency accepts the group's deliberations as a source of consensus advice or recommendations" (41 CFR § 101-6.1004(i)). This exclusion was applied in *Natural Resources Defense Counsel v. Herrington*, 637 F. Supp. 116 (D.D.C. 1986), where the court concluded that FACA did not apply to a panel of scientists convened by the U.S. Department of Energy to provide advice on the operation of a nuclear reactor, where the panel members would work independently and report individually.

In practice, these distinctions—between operational functions, exchange of information, and nonconsensus advice, on the one hand, and advice and recommendations, on the other—may sometimes be subtle. The line between advice and discussion of future operations is not a sharp one. Similarly, advice can be packaged as information. When an agency decides to meet with outsiders and rely on one or more of these three exclusions from FACA, careful, ongoing guidance and supervision will be required to ensure that the group does not inadvertently render consensus advice or recommendations, thereby triggering FACA.

Government contractors. FACA's legislative history states that the term "advisory committee" does not include a contractor or consultant hired by

* See H.R. Rep. No. 1017, 92 Cong., 2d Sess. (1972), reprinted in 1972 U.S. Code Cong. & Ad. News 3494 ("The term advisory committee as used in this bill does not include committees or commissions which have operational responsibilities.").

a federal agency (see *Food Chemical News v. Young*, 900 F. 2d 329, 331 (D.C. Cir. 1990), citing FACA's legislative history, and *Lonbardo v. Handler*, 397 F. Supp. 793, 797-800 (D.D.C. 1975)). The reason for this exclusion, as Judge Ruth Bader Ginsberg explained in *Food Chemical News*, is that government contractors, unlike the groups that prompted enactment of FACA, are subject to procurement regulations intended to provide a check against waste and bias (900 F. 2d at 331). Accordingly, FACA procedures generally do not apply to government contractors who provide advice to federal agencies pursuant to a government contract. In addition, government contractors are free to receive and evaluate advice from other entities, and to relay that advice, along with recommendations for dealing with the advice, to the contracting agency. Because the contractor's meetings with other individuals and entities are not subject to FACA, the contractor enjoys a level of flexibility and freedom from procedural burdens that the contracting agency does not.

However, the precise scope of the contractor exclusion is unclear. Notwithstanding the FACA legislative history and *Food Chemical News* case, those who provide advice to the federal government pursuant to a contract are not automatically exempted from FACA. In *Northwest Forest Resource Council* (846 F. Supp. at 1011), for example, although nonfederal members of the Forest Ecosystem Management Assessment Team performed their duties pursuant to contracts with the federal government, Judge Jackson nevertheless held that the Team was subject to FACA.* Accordingly, federal agencies should be cautious in applying this exemption to consultations that might otherwise be subject to FACA.

Effective use of FACA. Where a statute mandates creation of an advisory committee subject to FACA, or where agency decision makers conclude for policy reasons that a FACA advisory committee should be formed, the responsible agency should give careful consideration to the

organization of the committee and the terms of its mandate. The goal should be to create a structure that enables the agency to obtain the advice it needs, is sufficiently flexible to respond to changing circumstances, minimizes procedural burdens, and satisfies all applicable legal requirements.

One organizational model with potentially broad application is what we will call a "master" chartered advisory committee. Under this approach, the master committee receives and evaluates advice from other entities and relays that advice, along with its recommendations for dealing with the advice, to the sponsoring agency (an approach similar to the Food and Drug Administration's use of a contractor to obtain and evaluate advice from third parties, described in the *Food Chemical News* case). These other entities can be regular working groups or task forces that are formally associated with the master advisory committee, or they can be completely independent. The master committee, of course, may also provide consensus advice to the federal agency based on the expertise of its own members. Because its meetings with other individuals and entities are not subject to FACA, the master committee enjoys a level of flexibility and freedom from procedural burdens that the sponsoring agency does not. At the same time, because the master committee's deliberations on the advice received from third parties are subject to FACA, opportunities for public participation and scrutiny of the advisory committee's actions are preserved. An additional advantage of this approach is that it allows groups or individuals who do not want to be members of a federal advisory committee to nevertheless participate in the advisory process and provide advice to the master committee.

A second, related organizational technique is one we will call the "umbrella" charter. Under this approach, a single committee is chartered; the charter provides for subcomponents, which function essentially as subcommittees of the umbrella committee. In many situations, this type of organization may make sense from a management perspective. An additional, less substantive benefit of this approach is that it provides a means of coping with the Administration's self-imposed limits on the number of nonstatutory advisory committees. For example, where six independent advisory committees would be appropriate, but that number

*In a related context, the D.C. Circuit noted that "FACA would be rather easy to avoid if an agency could simply appoint 10 private citizens as special government employees for two days, and then have the committee receive the section 3(2) exemption as a body composed of full-time government employees" (*Ass'n of American Physicians and Surgeons*, 997 F. 2d at 915). The same reasoning arguably applies to contractors.

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exceeds the agency's quota, the agency can charter one advisory committee with six subcommittees without technically exceeding the quota.

Both of these techniques appear to be reflected in the committee structure employed by the government in the implementation of the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (see Standards and Guidelines at E-15 through E-17).

Addressing the issue through regulatory and statutory changes. Despite FACA constraints, advisory committee assistance in the ecosystem approach could be expedited by modifying administration policies on advisory committees. Ultimately, however, the most effective recourse would be to modify FACA through amendment.

Modifying Administration policies on advisory committees. Administration policies on FACA create a dilemma for federal land managers. The ecosystem approach requires numerous contacts between federal personnel and outsiders, many of which are subject to FACA. Therefore, federal land managers must either utilize existing advisory committees or create new committees. But Administration policy is to reduce the number of nonstatutory advisory committees, avoid creation of new statutory advisory subcommittees, and preclude exemption of advisory committees from FACA. It is difficult to reconcile these limitations on advisory committees with the need for advisory committees inherent in the ecosystem approach.

Accordingly, the Administration should revise its policies to ensure that federal land managers have adequate latitude to form advisory committees when they reasonably believe such committees are necessary to accomplish their management responsibilities under the ecosystem approach. This could be accomplished either by eliminating all numerical quotas on advisory committees, or by exempting ecosystem approach advisory committees from the quotas. Alternatively, quotas could be maintained if the relevant federal agencies were required to set aside enough committee slots to ensure approval of reasonable requests for ecosystem approach advisory committees.

In addition, the Administration should eliminate unnecessary impediments and minimize the procedures required to charter, operate, and renew necessary advisory committees. Opportunities should be explored for streamlining or eliminating the Office of Management and Budget approval process, simplifying or eliminating the General Services Administration review process codified at 41 CFR § 101-6.1007, and simplifying and expediting agency approval processes.

Amending FACA to create exemptions. One problem that could be appropriately resolved by amending FACA is the issue of consultations between the federal government and state and/or tribal governments, when the state or tribal representatives are acting in a sovereign capacity. Federal environmental and natural resource laws and policies have traditionally been predicated upon close coordination with state and tribal authorities. State jurisdiction remains concurrent with federal jurisdiction under numerous federal wildlife and natural resource statutes, and federal pollution control statutes such as the Clean Water Act, Clean Air Act, and Resource Conservation and Recovery Act include provisions for the federal government to "delegate" regulatory responsibility to the states. Several natural resource statutes, including the Endangered Species Act and National Forest Management Act, provide for consultation between federal and state officials. In addition, the application of FACA to contacts between federal officials and treaty Indian tribes may implicate the federal government's trust responsibilities to those tribes. Yet FACA does not expressly exempt such consultations from its coverage.

Several groups representing state and tribal officials have identified FACA as an impediment to effective coordination with the federal government, and have advocated an exemption for contacts with sovereign entities. Legislation exempting consultations with sovereigns from FACA in certain limited contexts suggests that there is some congressional support for this as well.

Accordingly, it has been suggested that the Administration propose legislation amending FACA to exempt contacts between federal officials and representatives of state or tribal governments acting in

a sovereign capacity. The resolution of the Western Governors' Association quoted above provides one possible model for such legislation.

This legislation may not be necessary in light of the Unfunded Mandates Reform Act signed by the President on March 22, 1995. Section 204 of Title II of the Act exempts from FACA actions in support of intergovernmental communications where meetings are held exclusively between federal officials and officials of state, local, and tribal governments, and where such meetings are "solely for the purposes of exchanging views, information, or advice relating to the management or implementation of Federal programs established pursuant to public law that explicitly or inherently share intergovernmental responsibilities or administration."

Amending other statutes to create FACA exemptions. An alternative would be to add FACA exemptions to federal laws where consultations with sovereigns are required or appropriate. Such statutes include the Endangered Species Act, National Environmental Policy Act, National Forest Management Act, Fish and Wildlife Coordination Act, Marine Mammal Protection Act, and the Fisheries Conservation and Management Act. Obviously, this approach would be more cumbersome and laborious than a single amendment to FACA.

Other Tools for Communicating With Stakeholders

The consensus-building that is needed for the ecosystem approach can be enhanced through processes mandated by the National Environmental Policy Act and through constructive approaches to the Federal Advisory Committee Act. In addition, other tools may expedite public participation in the ecosystem approach, including alternative dispute resolution and education.

Alternative dispute resolution. Increased participation in management of ecosystems by federal, state, and local agencies, tribes, and the public is a key goal of the ecosystem approach. However, stakeholder involvement may more sharply define particular areas of disagreement over vision, goals, priorities, and methods. Moreover, federal, state, and local governments may be reluctant to share decision-making authority with other sovereign authorities. For these reasons, attempts to increase

stakeholder participation should also include mechanisms for resolving disputes. Indeed, the very existence of a system for resolving disputes will reinforce the participatory process.

Dispute resolution may involve numerous processes, each with inherent benefits and weaknesses. Some of these mechanisms may include:

- Election or designation of a neutral individual to decide disputes. These processes, such as arbitration, have the benefit of providing for quick solutions to contentious issues and for help in resolving conflicting views. Potential weaknesses include possible bias toward one view or another.
- Establishment of a dispute resolution appeals process based on a hierarchy with national, regional, and local levels. This process would be similar to that used to resolve disputes between EPA and other federal agencies over compliance agreements involving federal facilities. Under this process, initial appeal of the terms of an agreement are handled at the facility level. If no consensus can be reached, then the next appeal is at the regional level of EPA and the affected agency, then to the national (department) agency level, and finally to the Office of Management and Budget or the Attorney General. The advantage of this system is that disputes can be resolved at the lowest possible level. The weakness is that an ultimate decision could be significantly delayed if appealed at multiple levels.
- Establishment of ecosystem-based councils that represent multiple interests. Such councils could be nationally, regionally, or locally based, and should include: federal, state, tribal, and local government interests; industry and regional development interests; private landowners; representatives from nonprofit organizations such as environmental groups; and the affected public. For example, the International Joint Commission was formed to assist the United States and Canada in protecting water quality in the Great Lakes basin ecosystem. This type of dispute resolution body has the advantage of increasing the likelihood of focused participation and consensus among the members,

especially if discussions are facilitated by a trained neutral. However, its determinations, when necessary, are not as timely as those made by a neutral individual.

- Implementation of alternative means of dispute resolution and negotiated rulemakings in the administrative process. The Administrative Dispute Resolution Act, 5 U.S.C. §§ 571 *et seq.*, authorizes and encourages the use of alternative means to resolve disputes in federal courts. This legislation establishes authority for the use of neutral conciliators, facilitators, and mediators to deal with disputes or controversies in administrative programs, and it authorizes the use of arbitration to resolve issues. Similarly, 5 U.S.C. §§ 561 *et seq.* encourage the use of negotiated rulemakings and encourages other innovative and experimental negotiated rulemaking procedures to reach consensus on administrative rulemakings. Although these techniques are untested in the context of the ecosystem approach, they serve as mechanisms for dispute resolution and consensus-building that could be usefully employed in efforts to implement the ecosystem approach.

Education. The use of more collaborative mechanisms for stakeholder involvement alone will not suffice to facilitate the ecosystem approach. The general public and local stakeholders need to be informed about the value of maintaining productive potential for ecosystems and of promoting sustainable economies and communities. Several statutes provide federal agencies with authority to create and fund education programs. These statutes should be utilized to the fullest extent practicable to educate stakeholders about the ecosystem approach, or to allow stakeholders to educate others.

For example, the National Environmental Education Act (NEEA) provides authority for launching ecosystem approach-based education programs and awarding education grants. In the NEEA, Congress explicitly recognized that “threats to human health and environmental quality are increasingly complex” (NEEA § 2). The NEEA establishes an Office of Environmental Education within EPA to develop model curricula and education materials and to work with other federal and nonfederal entities to improve understanding of “the relationships between humans and their environment,” among

other things (NEEA § 4). The Act also requires the Office of Environmental Education to assess the demand for professional skills and training needed to respond to current and anticipated environmental problems, and to coordinate environmental efforts with other federal agencies (NEEA § 4). In addition, the NEEA authorizes the EPA Administrator to enter into contracts or provide grant assistance to support the design, demonstration, and dissemination of environmental curricula and field techniques, including assessment of environmental and ecological conditions, and to promote the development of projects to understand and assess specific environmental issues (NEEA § 6). Several other grant and cooperative agreement authorities may also be used for environmental education and training under certain circumstances (for example, see Clean Water Act § 104).

The Secretary of Agriculture, in implementing Forest Service programs, is authorized to “enter into cooperative agreements with public or private agencies, organizations, institutions, or persons . . . to develop and publish cooperative environmental education and forest history materials” (16 U.S.C. § 565a). Under the Forest and Rangeland Renewable Resources Planning Act, the Secretary of Agriculture, “in cooperation with the State directors of cooperative extension service programs and eligible colleges and universities,” is directed to establish programs to expand public knowledge “of the ecological relationships and benefits of trees and related resources in urban and community environments . . . and to conduct a comprehensive natural resource and environmental education program for landowners and managers, public officials, and the public, with particular emphasis on youth” (16 U.S.C. § 1672).

COORDINATION WITH OTHER GOVERNMENTS

Ecosystem approaches are predicated on consensus-building with all stakeholders in an ecosystem. Often, stakeholders are agencies from nonfederal sovereign governments, including state and tribal governments or governments of other countries. Close coordination with these governments in arriving at collaborative solutions to shared environmental problems is vital to an effective ecosystem approach. In addition to the National Environmental Policy Act process described above, several authorities may be used to achieve this coordination.

Federal-State Relations

Good working relations between state and federal agencies are key to the ecosystem approach. Federal statutes facilitate state-federal cooperation in several ways: by fostering state-established regional plans for the ecosystem approach; by mitigating environmental damage through federal highway programs; by passing federal regulatory authorities to states; and by exchanging federal agency personnel with state agencies.

There are three general categories of state laws that may aid in the implementation of the ecosystem approach: state environmental laws; programs mandated by federal laws; and state-level land use laws. Commentators have noted that, with respect to the ecosystem approach, state environmental laws often have some of the same pros and cons as their federal counterparts. Several states also have general biodiversity laws or laws implementing Natural Heritage Programs. Most state biodiversity statutes consist of statements of policy and the establishment of research programs. Some states, such as California and Texas, have more innovative and substantive laws for biodiversity protection and ecosystem-level planning. These laws involve, among other things, partnerships with federal agencies under the Endangered Species Act. States are also required or encouraged to establish resource protection plans under several federal laws, including the Coastal Zone Management Act, the Aquatic Nuisance Prevention Control Act, and legislation regarding floodplain protection. These programs can be used to help protect ecological values. Finally, a handful of states, including California, Georgia, Hawaii, Maine, Oregon, and Rhode Island, have state-level zoning laws that regulate local planning and land use control processes.

Regional, county, and local zoning laws are also important to the ecosystem approach. A number of local land use laws may be relevant to collaborative ecosystem-based management efforts, including general welfare zoning for environmental and aesthetic objectives, floodplain zoning, open space preservation, wetland protection, and sensitive lands protection. In addition, regional planning statutes exist in various forms in several states. With some exceptions, regional programs are advisory and do not control the planning and land use control activities of local governments within regions. Regional planning agencies have also

been established for critical natural resource areas, including the New Jersey Pine Barrens. Further discussion of these laws is beyond the scope of this chapter.

Incorporating state-established regional plans.

Some states have enacted laws to protect natural resources on an ecosystem-wide basis. Where possible and appropriate, the federal government can take advantage of flexibility in federal laws to adapt its activities to conform to state laws or programs. For example, the Coastal Zone Management Act requires that federal agencies conduct their activities in a manner consistent with state coastal management plans (16 U.S.C. §§ 1451 *et seq.*). However, nothing prevents a federal agency from proceeding in a similar fashion even in the absence of a federal statutory requirement.

Another example involves a California law that established Natural Communities Conservation Planning, under which counties and cities are encouraged to adopt multispecies and multihabitat protection plans. Under this law, reserve areas are created that encompass combinations of imperiled types of habitat adequate to support sustainable populations of native animals and plants. When the Fish and Wildlife Service recently listed the California gnatcatcher as a threatened species, it promulgated a "special rule" under section 4(d) of the Endangered Species Act to delegate responsibility for protecting the gnatcatcher to California's Natural Communities Conservation Planning process. The special rule provided that if the relevant counties and cities adopted plans pursuant to scientific guidelines developed by state scientists, the Fish and Wildlife Service would review and approve the plans as a substitute for case-by-case, species-by-species review of every individual landowner plan to develop vacant land that might harbor a listed species. Under this approach, development could then proceed in all areas so designated by the plan, even if "incidental taking" of individual members of listed species might occur. The special rule provided that for those jurisdictions making satisfactory progress toward final plans, limited development could take place during the interim period, not to exceed 5 percent of the total habitat (subject to other scientific screening).

As a result of this action, private developers are working with state, county, and city governments, environmentalists, planners, and scientists in

Orange and San Diego Counties to develop Natural Communities Conservation Plans. Whether adequate and equitable means can be found to fund the acquisition or creation of needed preserve areas remains to be seen. However, this kind of federal-state cooperation on an ecosystem-wide basis sets a precedent with enormous potential benefits to species at risk, local government bodies, and developers.

State assumption of federal authorities. A number of federal statutes provide opportunities for states to assume lead authority to administer environmental programs. For example, under the Clean Water Act, almost 40 states now issue point source water pollution discharge permits under federally approved state programs; many states also have delegated programs under the Clean Air Act and the Resource Conservation and Recovery Act. Other programs have been adopted by fewer states; for example, only two states operate programs under Clean Water Act section 404(g), which authorizes states to assume responsibility for administering their own programs for the discharge of dredged or fill material into navigable waters of the United States. Given the significance of these delegations, agencies such as EPA, NOAA, and the Office of Surface Mining should work with the states to encourage partnerships that further the ecosystem approach.

Endangered Species Act implementation.

State, tribal, and local governments have expressed strong interest in greater utilization of their expertise and in playing a greater role in the implementation of the Endangered Species Act (ESA). The Clinton Administration has initiated several reforms to establish a new cooperative federal-state relationship to achieve ESA goals. With respect to the states, this includes several initiatives:

- The Fish and Wildlife Service and National Marine Fisheries Service have issued a policy directive that recognizes the general authority and responsibility of state fish and wildlife agencies for resident wildlife protection. The policy directive requires that state expertise and information be used to the maximum extent possible in prelisting, listing, consultation, recovery, and conservation planning.
- Recommendations for Congress to amend the ESA include: explicitly encouraging and recognizing comprehensive agreements to conserve species within a state among all appropriate jurisdictional state and federal agencies; requiring that special consideration be given to state scientific knowledge and information on listing decisions; providing states the opportunity to assume lead responsibility for developing recovery plans and implementation agreements; specifically authorizing appropriate state agencies, as well as Fish and Wildlife Service and National Marine Fisheries Service, to enter into voluntary prelisting agreements with cooperating landowners to implement the "no surprises" policy.

Intergovernmental Personnel Act. The Intergovernmental Personnel Act of 1970, 5 U.S.C. §§ 3371-3376, authorizes federal, state, and local government employees to be temporarily reassigned to offices at other levels of government, as well as to tribal government and universities, to work on areas of mutual concern to the organizations involved. The Act could be a useful tool for the ecosystem approach because it provides a statutory mechanism for transferring and sharing expertise between different levels of government.

State and federal resource managers in the Pacific Northwest have taken advantage of the Intergovernmental Personnel Act to facilitate implementation of the Forest Plan. An official from the Washington State Department of Fish and Wildlife is currently on a 2-year detail (with option to extend) with the Fish and Wildlife Service to work on habitat conservation planning initiatives under the Endangered Species Act. To help develop successful Habitat Conservation Plans and to work with private companies, the Fish and Wildlife Service needs to coordinate closely and form partnerships with other government entities, particularly the states and tribes. The state official's detail provides an opportunity to benefit the operations of both the state and the Fish and Wildlife Service, and to ensure close coordination between governments. The official involved has a long-standing relationship not only with other state employees and agencies, but also with many tribal representatives.

Under the Intergovernmental Personnel Act, there are other personnel exchanges in the Pacific Northwest, as well: a tribal biologist is on detail with the Bureau of Indian Affairs, and a representative from the watershed analysis committee is on detail with the Forest Service. The biologist has a longstanding relationship with federal, state, tribal, and industrial employees.

Federal-Tribal Relations

American Indian tribes currently maintain jurisdiction over approximately 56 million acres of land on 278 reservations in the lower 48 states. Most lands controlled by American Indians are held in trust by the federal government for both tribes and individual Indians. American Indian trust lands have a unique status: even though the United States has fee title in trust lands, it is the American Indian landholders who have full beneficial rights (and interests) to those lands. The federal government has a responsibility to tribes and Indian people to manage and protect trust lands and environments (including natural resources held in trust) under treaties, federal statutes, regulations, and/or executive orders. The governing statutes, regulations, executive orders, and treaties define the scope of this trust responsibility, which is a federal responsibility. Federal agencies should coordinate their activities and authorities to implement it.

Tribal rights and interests in treaty-protected resources based off the reservation (such as fish and game) have also been recognized. For example, in the Pacific Northwest, several treaties signed in the mid-1800s preserve tribal rights to fish in the Columbia River, its tributaries, and the Puget Sound watershed, and to hunt on off-reservation federal lands. Tribes have also received recognition of their rights and interests in and to water resources that stem from off-reservation sources to ensure that waterflows and water quality are sufficient to support and/or maintain these hunting and fishing rights.

Specific issues of contention arise where ecosystems encompass all or part of American Indian trust lands and part of state or federal lands, or where tribal off-reservation treaty-protected resources are located in ecosystems on state and/or federal lands. For example, representatives of three tribal commissions are formally involved in implementation of the Pacific Northwest Forest

Plan. However, tribal representatives interviewed in the Northwest asserted that tribal interests have not been sufficiently considered in accordance with treaty-based principles. Representatives contended, among other things, that the government treats tribes as members of the public rather than as sovereigns or as groups with whom the government has a trust relationship, and that the government's planning and implementation processes do not adequately consider treaty rights to fishing and off-reservation hunting.

In addition, tribes possess sovereignty over tribal lands. Pursuant to the principle of tribal sovereignty, tribes generally possess the authority to regulate certain environmental matters on their lands, as long as that authority does not conflict with congressional authorizations. Several pollution control statutes, such as the Clean Water Act, increasingly provide authority for the federal government to treat tribes in the same manner as states for purposes of running their own delegated programs. In addition, in the context of the Endangered Species Act, the Administration recently announced a policy to provide greater opportunities for tribal governments in carrying out the Act.

In some cases, there is legal uncertainty regarding when and where tribal jurisdiction or interests end and state and local interests begin. The impact of the federal trust responsibility also remains unclear. Tribal rights and interests in off-reservation resources are still evolving within the courts, making it difficult to determine how to address these issues within the framework of the ecosystem approach.

International Instruments and Institutions

The ecosystem approach often has an important international component. The management of some ecosystems, such as the Great Lakes, inevitably raises international issues because the ecosystem itself straddles international borders. Taking an ecosystem approach in border regions typically requires the cooperation of the neighboring country that shares jurisdiction over the ecosystem. Moreover, the health of an ecosystem located entirely within one nation (such as the Chesapeake Bay) can be critical to the health of an ecosystem in another nation where species integral to both ecosystems migrate between the

two. Efforts to implement the ecosystem approach within the United States may affect the environment of other nations or of the global commons.

The ecosystem approach can be affected by international rights, obligations, and institutions. International law presents obligations to protect ecosystems in the context of domestic, transboundary, or global environmental harms, and tools for meeting these obligations. International environmental law includes several types of agreements and commitments: a wide range of binding international, regional, and bilateral environmental agreements; rules of customary international law, such as those relating to transboundary pollution; and other types of commitments or "soft-law" declarations, such as the Rio Declaration on Environment and Development and Agenda 21, agreed upon by heads of state at the U.N. Conference on Environment and Development in June 1992. Because relevant international law can apply at several levels—global, regional, or bilateral—and may be ecosystem-specific or general, it is essential to review international law for relevance with respect to each ecosystem.

International agreements can enhance the ability of the United States to manage ecosystems and promote ecosystem protection in the global commons or on a broader regional or global scale. A number of agreements directly concern particular ecosystems or a set of ecosystems. For example, the Ramsar Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (1971) seeks to stem the loss of wetlands and waterfowl habitat through identification, listing, and protection in these areas. The U.N. Convention on the Law of the Sea (1982) (signed but not yet ratified by the United States) establishes comprehensive rights and obligations with respect to uses of the oceans. Among other things, it obligates parties to take measures to prevent, reduce, and control pollution of the marine environment (Art. 194:1) and to take measures "necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened, or endangered species and other forms of marine life" (Art. 194:5). The Biodiversity Convention, also signed but not yet ratified by the United States, obligates parties, among other things, to conserve biodiversity and ecosystems through restoration and prevention.

The United States is also a signatory (though not yet a party) to the U.N. Economic Commission for Europe Convention on Environmental Impact Assessment in a Transboundary Context (the "Espoo Convention"). This agreement, expected to enter into force shortly, requires parties to take measures to prevent, reduce, and control significant adverse transboundary environmental impacts from proposed activities, and to prepare environmental impact assessment documents for specified activities likely to cause such impacts, including installation of smelters, pulp/paper operations, major mining actions, construction of dams, and deforestation of large areas. The assessment shall, *inter alia*, describe the proposed activity, reasonable alternatives, impacts, and mitigation measures, and shall provide for public participation. "Impact" includes effects on flora, fauna, soil, air, water, landscape, or the interaction among these factors.

With regard to U.S. international boundary regions, the 1978 Agreement on Great Lakes Water Quality between the United States and Canada significantly restricts the discharge of toxic chemicals into the Great Lakes. The 1987 protocol to the Agreement calls for protection of the Great Lakes basin ecosystem through, among other things, controls on ground water contamination and airborne transport of contaminants. Other agreements on aquatic systems in border areas include the Agreement Approving Minute 242 of the IBWC Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River (United States–Mexico) (1973) and the Ottawa Agreement Regarding the Establishment of a Canada–U.S. Committee on Water Quality in the St. John River and Its Tributary Rivers and Streams Which Cross the Canada–U.S. Boundary (1972).

The 1993 North American Agreement for Environmental Cooperation (i.e., the NAFTA environmental side agreement) establishes an excellent framework for supporting comprehensive efforts to cooperatively manage shared ecosystems with Mexico and Canada. The Agreement sets forth a list of environmental issues that the parties may address, including: transboundary environmental issues; the conservation of plants, animals, and their habitats; and specially protected areas (Article 10:2). Other agreements relating to ecosystem-based work with Canada and Mexico

include the 1983 La Paz Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (United States–Mexico) and annexes, particularly Annex II—Agreement for Cooperation Regarding Pollution of the Environment along the Inland International Boundary by Discharges of Hazardous Substances—and Annex V—Agreement of Cooperation Regarding International Transport of Urban Air Pollution.

Many other international agreements or commitments, although not pertinent to specific ecosystems, address environmental issues of critical importance to the protection and management of ecosystems. These agreements include: the World Heritage Convention (1972) (requiring parties to identify and protect listed heritage sites); the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973) (prohibiting and regulating commercial trade in listed species at risk of extinction); the United Nations Framework Convention on Climate Change (1992); the Vienna Convention for the Protection of the Ozone Layer; and the Montreal Protocol to the Vienna Convention (1978). Of particular interest are agreements that seek to protect species that inhabit more than one ecosystem in more than one national jurisdiction. These agreements include: the Migratory Bird Treaties between the United States and Canada (1916), Mexico (1936), and Japan (1972); the Convention for the Regulation of Whaling (1946), and its Protocol (1956); and bilateral and multilateral fisheries agreements. Some agreements of this kind may potentially implicate treaty hunting or fishing rights of Indian tribes (for example, the United States–Canadian Treaty Concerning Pacific Salmon (1985) implicates treaty fishing rights of certain Indian tribes in the Pacific Northwest).

In addition to creating obligations to protect certain species, ecosystem types, or natural resources, many international agreements provide institutional and other means to assist efforts to implement the ecosystem approach. In addition, many bilateral agreements that provide for the exchange of technical and scientific information and personnel can be implemented to benefit the ecosystem approach.

Finally, nonbinding international policy instruments can also guide implementation of the ecosystem approach. Instances include the Rio

Declaration, which sets forth overarching principles to promote sustainable development, and Agenda 21, a “blueprint” for sustainable development, with action plans for (among other things) managing fragile ecosystems, promoting sustainable agriculture, conserving biological diversity, and integrating environment and development in decision making.

A number of difficulties are associated with use of international instruments to promote the ecosystem approach. International agreements that focus on a single set of environmental problems may assist the ecosystem approach in some situations, but may also impose constraints on the flexibility of ecosystem managers. For example, the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter at Sea (the “London Convention”) limits dumping at sea of radioactive materials and industrial waste. Although this provision may assist efforts to protect marine ecosystems, it may also foreclose the option of ocean disposal of waste, potentially putting additional pressure on land-based waste disposal options.

The usefulness of many international agreements is diminished by inadequate or qualified means of enforcement. Lack of knowledge also prevents their use: managers may not understand their provisions, or even know that they exist. The international legal system is complex, containing hundreds of environmental agreements. Providing managers with information on these agreements, their obligations, and their usefulness as tools should be a priority.

In survey team studies, agency representatives frequently noted that the lack of easy mechanisms for joint expenditures or transfer of funds under international agreements hindered coordinated bilateral efforts. A model that has reportedly been successful in this respect is an agreement between the United States and Canada agreement establishing the Great Lakes Fisheries Commission, under which funds go to the Commission itself for expenditure on ecosystem-related activities in either country.

ADAPTIVE MANAGEMENT

Adaptive management is a continuing process of action-based planning, monitoring, researching, and adjusting to achieve management goals for an

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ecosystem. As explained in the chapter on Science and Information, a formal process of adaptive management is required to meet the objectives of the ecosystem approach. At its core, adaptive management involves the identification, evaluation, and incorporation of new information into existing or modified management decisions.

National Environmental Policy Act

This one overarching statute already provides many of the goals and processes needed for the ecosystem approach, and is partly responsible for many of the efforts to implement the ecosystem approach that were studied by survey teams (Interagency Ecosystem Management Task Force 1995, volume 3). Why, then, has management not been more adaptive? The answer may be found in the barriers to adaptive management identified in survey team studies: lack of monitoring, failure to convey ecosystem data between agencies and stakeholders, and failure to incorporate this information in responsive agency decision making. In short, the NEPA process has not always effectively ensured that the environmental information gathered by agencies is verified over time or communicated to others in a form that is useable for future analyses.

Where an agency or group of agencies has developed an environmental impact statement, regulations by the Council on Environmental Quality provide that a monitoring program "may" be provided "and should be done for important cases" (40 CFR § 1505.3). Agencies must adopt monitoring and enforcement programs "where applicable for any mitigation" (40 CFR § 1505.2(c)), and mitigation and other conditions that are committed as part of the decision must be implemented by an agency. Upon request, the agency must inform co-operating or commenting agencies on progress in carrying out these mitigation measures. Moreover, a supplemental environmental impact statement must be prepared if the agency finds significant new circumstances or information, or if it makes substantial changes in its action that are relevant to environmental concerns (40 CFR § 1502.9(c)).

Although these provisions suggest that agencies should engage in some form of monitoring, it appears that some agencies do not gather, monitor, and use ecological information in a systematic manner. For the great majority of actions, for which only an environmental assessment and

finding of no significant impact are produced, monitoring is not conducted, though the finding of "no significant impact" may be based on assumptions or mitigation that will not be verified through monitoring. Where monitoring is carried out under the NEPA process, there is no assurance that monitoring data and approaches are developed and shared with other federal agencies and nonfederal entities in the same ecosystem or region.

Guidance could be issued by the Council on Environmental Quality on the monitoring approaches necessary to ensure that agencies take an adaptive management approach where appropriate in implementing federal actions. The Council is establishing accessible data bases of NEPA-generated information and monitoring at regional and subregional levels to avoid duplication of effort, improve coordination, and shape site-specific as well as regional-scale federal activities. Inventories of NEPA-generated information are currently being compiled and maintained in the Great Lakes basin (see chapter on the Great Lakes basin, volume 3, Interagency Ecosystem Management Task Force 1995).

The requirement to supplement NEPA documents was raised in some survey team studies as a possible impediment to adaptive management. New NEPA documents may need to be generated or old documents supplemented more frequently if significant new information is more systematically acquired. In cases where an environmental impact statement or supplemental environmental impact statement must be prepared, problems may arise due to limited resources and the need to make timely adaptive management adjustments. This concern could be addressed, and adaptive management could be facilitated, through interagency, programmatic NEPA approaches that provide a coordinated evaluation of the ecosystems of a given area and federal activities therein, either in the form of an environmental impact statement or a general environmental assessment. These approaches could be used to preevaluate a range of modifications for site-specific proposals when new information is developed, to preestablish monitoring thresholds within which a tiered environmental assessment will be appropriate, and to coordinate an interagency monitoring program that can serve as a data base for future NEPA analyses. Council on Environmental Quality provisions for tiering analysis (1502.20) and for planned

supplementation of an environmental impact statement (1502.5(a)) make clear that environmental impact statement analysis need not be limited to a single decision point, but rather may be continuously updated using improved computer technology, and then used in agency decision making. This approach has the added benefit of encouraging long-term planning and the establishment of benchmarks—two essential components of effective monitoring and adaptive management.

To ensure maximum predictability for federal managers and the public, affirmative steps could be taken to harmonize NEPA's supplementation requirement with adaptive management. One step that agencies can take is to lay out in their NEPA documentation how their proposals will be modified when new information is uncovered or when preestablished monitoring thresholds are crossed. Of course, in some cases agencies will not be able to anticipate program modifications. However, if an agency spells out contingencies in an environmental impact statement ahead of time, and if stakeholders have an opportunity to comment, management changes can be made without further NEPA supplementation, as long as the changes and associated impacts have already been analyzed under NEPA. Finally, Council on Environmental Quality guidance could increase the likelihood that reviewing courts will approve this or other approaches to supporting adaptive management.

Endangered Species Act

The requirement that agencies utilize their authorities to further the purposes of the Endangered Species Act (ESA) implicitly authorizes federal agencies to use adaptive management in their ongoing activities, consistent with their existing authorities, wherever appropriate to protect and recover federally listed species and the ecosystems upon which they depend (ESA § 7(a)(1)). Where actions authorized, funded, or carried out by federal agencies may affect federally listed endangered or threatened species, ESA requirements are relevant to adaptive management. At the time of initial consultation between an acting agency and the appropriate consulting agency (the Fish and Wildlife Service and/or National Marine Fisheries Service), the agencies may discuss and jointly develop mitigation measures and alternatives to ensure that the action is not likely to jeopardize listed species or adversely modify designated

critical habitat. However, when formal consultation is completed and the action proceeds, "[i]f new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered," reinitiation of consultation is required to ensure careful evaluation of the information (50 CFR § 402.16). Similarly, "if the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered," or "if a new species is listed or critical habitat designated that may be affected by the identified action," then further consultation must occur (*id.*). These requirements effectively place a duty on federal agencies to monitor their actions for such factors after consultation.

In addition, where the consulting agency has authorized the "taking" (harming or killing) of some members of a listed species—where the take will not likely jeopardize the species, and measures have been taken to minimize it—the agency must report the progress of the action and its impact on the species to the consulting agency, as specified in an "incidental take statement" (50 CFR § 402.14 (i)). Moreover, if the amount or extent of the authorized take is exceeded, the federal agency must reinitiate consultation (50 CFR § 402.16).

Because these duties apply where discretionary federal involvement or control over an action has been retained or is authorized by law, they require management to be adapted over time to ensure that takes are documented and that listed species are not subsequently placed in jeopardy (50 CFR § 402.03). Moreover, in preparing Habitat Conservation Plans, nonfederal entities and individuals must specify the steps they will take to monitor impacts, and the procedures they will follow to deal with unforeseen circumstances; in addition, the Fish and Wildlife Service or National Marine Fisheries Service may require monitoring and reporting conditions to fulfill the purposes of the permit and plan (50 CFR § 17.22). Under current regulations, the Fish and Wildlife Service and National Marine Fisheries Service are required to "rely upon existing reporting requirements to the maximum extent practicable" (50 CFR § 17.22). However, as under the National Environmental Policy Act, current implementation practices under the ESA may not be fully consistent with adaptive management, because they are not part of a program of systematic monitoring and adaptation.

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Finally, the Fish and Wildlife Service and National Marine Fisheries Service recently declared a cooperative policy for an ecosystem approach. The policy explicitly endorses the use of adaptive management as a means of incorporating ecosystem considerations into activities under the Endangered Species Act. It calls on agency decision makers to "[p]rioritize actions and system monitoring schemes to meet specific objectives for genetic resources, species populations, biological communities, and ecological processes through carefully designed adaptive management strategies" (Notice of Interagency Cooperative Policy for the Ecosystem Approach to the Endangered Species Act, 59 Fed. Reg. 34,273 (1994)).

RECOMMENDATIONS

Based on careful review of survey team studies, recommendations were made for beginning to address the legal issues discussed throughout this chapter. These recommendations are summarized below.

Agencies should consider, where appropriate and to the extent permitted by law, the following activities or approaches:

- ***Pursuing the goals of the ecosystem approach.*** Agencies should:

- Continue movement towards a preventive, ecosystem-oriented approach in implementing the Endangered Species Act.
- Make more focused and flexible use of authorities under pollution control statutes to further community-based environmental protection.
- Explore more rigorous use of mission agency authorities to protect ecological values and ensure sustainable development.
- Make more consistent, scientifically grounded use of authorities in federal land management statutes to protect ecological values and promote sustainable economies and communities.
- Explore means of more fully integrating ecological, economic, and social sustainability factors in the National

Environmental Policy Act process, wherever appropriate.

- ***Working and coordinating on an ecosystem-wide basis.*** Agencies should:

- Create interagency teams in each region of the country through memoranda of agreement, or establish these memoranda strategically in priority or at-risk regions.
- Use the National Environmental Policy Act as a framework for regional interagency ecosystem plans, working with nonfederal governments and stakeholders.
- Under the Council on Environmental Quality's leadership, develop guidance on baseline ecosystem and socioeconomic assessment techniques, interagency coordination, and other ways to further the ecosystem approach through the NEPA process.
- Under the Endangered Species Act, continue to work with other agencies to define the appropriate approach to consultation in the context of the ecosystem approach, and to supplement their regulations or issue guidance to support this approach. This applies in particular to the Fish and Wildlife Service and National Marine Fisheries Service. Recommend that Congress amend the Endangered Species Act to require state and federal agencies to develop agreements to implement recovery plans, and to provide states with greater roles in management of species—including listing, recovery plans, and agreements with private landowners.
- Take an ecosystem approach to Fisheries Management Plans through, *inter alia*, the habitat sections in the Plans, and through incorporation of other federal, state, and tribal fishery conservation and management measures.
- Explore opportunities to replace existing national regulations or other authorities with regulations, delegations of authority, or guidance documents that are directed

towards supporting cooperative efforts in specific regions.

- Consider using Natural Resource Damage Assessment or National Contingency Plan models for other interagency activities.
- Implement environmental laws by:
 - Directing enforcement activities towards collaboratively developed ecosystem management goals.
 - Considering ecosystem implications when administering federal pollution control statutes.
 - Integrating EPA enforcement activities under the Clean Water Act and Oil Pollution Act, cleanup activities under the Comprehensive Environmental Response, Compensation, and Liability Act, and federal, state, and tribal natural resource damage programs to develop restoration programs on an ecosystem basis, where appropriate, and improve interagency coordination on cleanup decisions.
 - Ensuring that Supplemental Environmental Projects are consistent with or complement any relevant efforts to implement the ecosystem approach.
 - Encouraging legislation that would set in motion collaborative, science-based efforts to manage specific geographical areas identified as nationally or regionally significant, using models such as the New Jersey Pinelands legislation or the National Estuary Program.
 - Reviewing existing authorities for interagency cooperation, including impediments in grant-making authorities and interagency agreements, and proposing revisions to reduce non-statutory barriers. Consider recommending legislation to eliminate statutory barriers, such as Internal Revenue Code disincentives to long-term personnel details.

• ***Forming partnerships with private landowners.*** Agencies should:

- Use wetlands mitigation banking to prioritize areas for restoration and consider models like the New Jersey Pinelands development credits program.
- Consider establishing government information centers, in conjunction with states, to assist private landowners and developers in complying with environmental permitting requirements.
- Explore models for consolidation of permits.
- Consider expanded use of Cooperative Forestry and other programs to foster partnerships with private landowners.
- Explore additional ways to use Habitat Conservation Plans under the Endangered Species Act to provide more certainty for landowners, including recommendations that the Act be amended to provide that landowners who develop Habitat Conservation Plans are not subject to later demands for larger land or financial commitment.

• ***Communicating and working with stakeholders.*** In pursuing options to ensure consistency with Federal Advisory Committee Act (FACA) requirements, agencies should:

- Develop training and guidance for federal agency personnel on FACA compliance to ensure that they (1) recognize when FACA does and does not apply, and (2) know the most effective approaches for chartering and operating advisory committees under existing law and regulations.
- Modify Administration policies to eliminate limits on the number of nonstatutory advisory committees, or take other steps to ensure that limits do not create a barrier to creation of necessary ecosystem approach advisory committees.

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- Recognize that Title II of the Unfunded Mandates Reform Act exempts from FACA many actions in support of inter-governmental communications relating to management or implementation of federal programs.

In pursuing other options for promoting communication and cooperation with stakeholders, agencies should:

- Use authorities to educate stakeholders about the goals of the ecosystem approach.
- Explore means of providing funding and technical assistance to local stakeholders who make efforts to implement the ecosystem approach.

Council on Environmental Quality guidance should be developed with a view to making the National Environmental Policy Act process more supportive of active and collaborative stakeholder involvement, both where agencies act individually and where they plan together.

- ***Promoting adaptive management.*** Agencies should:

- Improve the frequency and quality of monitoring under the National Environmental Policy Act (NEPA) and establish inventories of NEPA-generated information at regional and subregional levels.
- Explore using contingent analyses under NEPA (including monitoring thresholds and analysis of alternative courses of action) to enhance adaptive management and reduce inappropriate supplementation burdens.

- ***Coordinating with other governments.*** Agencies should:

- Work with state, local, and tribal governments to take advantage of available opportunities for building an orientation toward the ecosystem approach into state and tribal programs.
- Use the Intergovernmental Personnel Act to coordinate and form partnerships with other government entities, including states, tribes, and local governments.

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